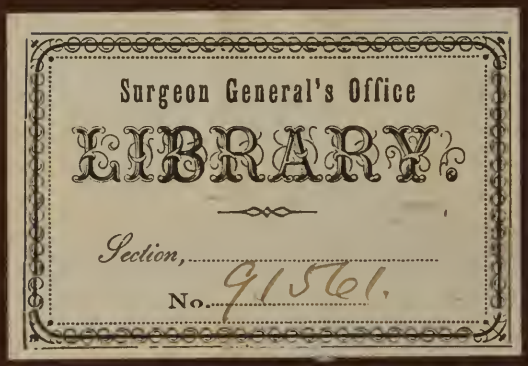
Orthopædic Surgery.

Hutchison.



CONTRIBUTIONS

TO

ORTHOPEDIC SURGERY:

INCLUDING

OBSERVATIONS

ON THE TREATMENT OF CHRONIC INFLAMMATION OF THE HIP, KNEE, AND ANKLE JOINTS, BY A NEW AND SIMPLE METHOD OF EXTENSION, THE PHYSIOLOGICAL METHOD;

AND

LECTURES ON CLUB-FOOT,

DELIVERED AT THE COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK (SPECIAL COURSE).

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NEW YORK:
G. P. PUTNAM'S SONS,
182 FIFTH AVENUE.
1880.

Stereotyped and Printed
By Rand, Avery, & Company,
117 Franklin Street,
Boston.

DEDICATION.

TO

EDWARD R. SQUIBB, M.D.,

LATE PASSED ASSISTANT SURGEON, UNITED STATES NAVY,

This Book is Inscribed,

IN RECOGNITION OF HIS DISTINGUISHED PROFESSIONAL AND SCIENTIFIC ATTAINMENTS, AND OF THOSE STERLING QUALITIES OF TRUE MANLINESS WHICH CONSTITUTE MORAL GREATNESS; BUT MORE ESPECIALLY

IN GRATEFUL APPRECIATION

OF NUMEROUS ACTS OF PERSONAL KINDNESS, AND AN UNINTERRUPTED FRIENDSHIP OF MANY YEARS' STANDING, BEGINNING WHEN HE WAS ASSISTANT DEMONSTRATOR OF ANATOMY IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA, AND GAVE THE WRITER HIS FIRST LESSONS IN PRACTICAL ANATOMY.

PREFACE.

THE substance of the observations contained in this volume, on the Treatment of Chronic Inflammation of the Hip, Knee, and Ankle Joints, by what I have denominated, the "Physiological Method" of Extension, was first published in the *American Journal of the Medical Sciences*, for January, 1879, and in the Proceedings of the Kings County, New York, Medical Society, for April, 1879. The favorable notice which these papers received from surgeons of experience and acknowledged ability, has induced me to revise them, and to make such additions as have been suggested by a more extended observation of the results of the treatment recommended. I present them in the present form, in the full confidence that the adoption of the treatment by others, will be followed by results equal to these which I have obtained.

The Lectures on Club-Foot, comprise the author's personal experience in this interesting class of deformities, both in hospital and private practice. They were delivered before the Medical Class of the New-York College

of Physicians and Surgeons, and were subsequently published in the *Medical Record*, New York, 1878–79. They have been revised and reproduced, with additions, in this more permanent form, with the hope that they may supply a simple and practical guide for the treatment of club-foot, to the medical student and to the general practitioner, for whom they were especially designed.

The author desires to acknowledge his indebtedness to Dr. T. P. Corbally, for valuable assistance in carrying the volume through the press, and in relieving him of editorial work which would have greatly taxed one otherwise much engaged.

479 Clinton Avenue, Brooklyn, N.Y.
May, 1880.

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ORTHOPEDIC SURGERY.

ON THE TREATMENT OF CHRONIC INFLAMMATION OF THE HIP, KNEE, AND ANKLE JOINTS.

It is not my design to consider the symptoms, causes and pathology of the various inflammatory diseases which affect the joints, for this has been done, again and again, in surgical text-books, and in numerous monographs, which are accessible to the student of surgery. My purpose is, to describe a plan for the treatment of chronic inflammation of the joints of the lower extremity, by methods which I think are more simple, effective and agreeable to the patient, than those hitherto employed.

It may be stated, at the outset, that morbid conditions of the joints are, as a rule, essentially chronic, and whether the disease originates in the synovial membrane, the cartilages, the bones or the investing fibrous capsule, ultimately, the morbid action involves all the tissues, so that, without the previous history as a guide, it is often impossible to determine in what tissue the inflammation began. It is, to my mind, merely a pathological refinement, in most cases of joint disease, especially in childhood, to attempt to describe the symptoms indicating distinct pathological states of the individual structures composing a joint. The

treatment would be essentially the same, whether one or all of the articular structures are contemporaneously involved.

Surgeons of the present day pretty generally admit that the indications for the treatment of inflammation of the joints of the lower extremities, are: (1), to obtain extension of the limb; (2), to secure immobility of the joint; (3), to remove the superincumbent weight of the body; (4), to provide means to enable the patient to take exercise in the open air. The accomplishment of these indications, and the use of judicious medication and proper hygienic influences, comprehend all the principles of treatment.

The object of *extension is* — (1) To correct the malposition of the limb. An inflamed joint is never straight; it involuntarily becomes flexed, nor is it possible for the patient to prevent or to change this position. The flexion takes place slowly, almost imperceptibly, but surely, even when the limb has been permitted to rest quietly in bed, undisturbed either by the patient or the nurse; the degree of flexion depends upon the intensity or the duration of the disease. Every joint, when it becomes inflamed, assumes a characteristic *position*, which it is important to know, not merely as a diagnostic sign, but also as a point which may be made useful in treatment. When the *hip-joint* is inflamed, the thigh is flexed on the pelvis, and, as a rule, is slightly adducted. The *knee-joint*, when inflamed, is always more or less flexed. In the case of the *ankle-joint*, the foot is flexed upon the leg, the heel is raised by the gastrocnemii, and the toes point downwards. The *improper position* which the joint assumes, should be corrected as soon as possible, even when the inflammation is acute; this is important, in order that the different structures of the joint may not be kept in a state of undue pressure, or of inordinate ten-

sion, either of which conditions interferes with healthy nutrition, and so interferes with the curative process. As the joint becomes straightened, under the influence of extension, the patient experiences an almost immediate diminution of pain. (2) By means of extension, we also overcome the spasm and contraction of the muscles, which, by reflex contraction, press together the inflamed articular surfaces, and constitute the chief cause of pain in joint-inflammations; but, I do not believe it possible, by any amount of extension that can be applied, to separate the inflamed and swollen interior surfaces of the joint, so as to relieve them from pressure and the consequent pain. What we do accomplish by extension is, the relief of spasm and of muscular shortening; and to quiet the muscles is an imperative therapeutic axiom.

It is generally conceded that extension is an important element in the treatment of joint diseases, although we may differ as to the best method of obtaining it and the way in which the good results are achieved, still there is not so much unanimity as to the importance of the *fixation* of the joint. Many American authorities maintain that motion in the joint, at the same time that extension is made, is a *sine qua non* to success, and they have devised ingenious instruments for simultaneously accomplishing these two indications. It is difficult to understand why motion should be desirable in the treatment of inflammation of the hip-joint, when we consider it important to secure immobility in inflammation of all other joints. But the "American idea," as our English friends term it, goes still further: we must not only have motion with extension, but motion without friction, a condition which, with all due respect, seems to me to be a mechanical absurdity, because the tissues covering the joint surfaces are swollen

by inflammatory deposits, and the opposing surfaces must rub against each other when moved. We might with equal propriety speak of sound without vibration of the air.

Immobility of an inflamed joint, absolute and complete, is a primary, and essential condition of its local treatment. The more effectually this is secured, the more rapidly and perfectly the joint recovers its normal condition, and the less danger there is of its being permanently damaged. The greatest obstacle to recovery is friction of the inflamed surfaces. I do not mean a mere limitation of the movements of the joint — such "rest" as is obtained by placing the limb upon a soft bed or a pillow — but the perfect fixation secured by a splint or other means, which admits of no motion whatever. I am aware that many excellent surgeons believe that the danger of irreparable structural change and anchylosis of the joint, is very great, from prolonged fixation. This, I am sure, is an error. There may be a temporary anchylosis, such as arises from a diminution of the elasticity of the articular cartilages, and an enfeebling of the ligaments and the muscles from disuse; but, such changes are temporary or need only be so, for, by careful and steadily increasing use, reparation takes place in all these structures, and, after a time, they show no defect. I have never seen true anchylosis when the joint has been immovably fixed until the inflammation has subsided, except in cases of extensive destruction of the joint-structures, in which case, a cure by anchylosis is the thing to be desired. Exceptional cases, no doubt occur, but the anchylosis takes place more commonly when fixation is incomplete, and more or less motion and friction are permitted, before the inflammation has entirely subsided.

In corroboration of these views I quote from a paper by Pro-

fessor Verneuil on this subject, lately read before the "Société de Chirurgie de Paris," *Medical Times and Gazette*, Oct. 18, 1879. "Professor Verneuil said, 'Anchylosis, in fact, is a ghost, which frightens, not only the lay public, the patients and their friends, but also nearly all general practitioners, and not a few surgeons.' . . . 'I affirm,' he continues, 'that there does not exist a single fact which shows, conclusively, that fixation, however long continued, has ever led to anchylosis. . . . I might mention numberless examples of well-known cases in which the joint, for a long time kept immovably fixed, has, notwithstanding, retained its structure, and rapidly resumed its functions when permitted to do so.' . . . He admits that, at the termination of any arthritis, in the treatment of which fixation, more or less prolonged, has been made use of, there is a diminution, a suspension, even an abolition of movement; but does not see why this functional suppression should be attributed to fixation, rather than to other causes, especially the anatomical lesions present in the joint. . . . Impaired movement is, in all cases, due to the disease, and not to the fixation. . . . The exaggerated fear, therefore, of anchylosis, has caused many practitioners to commit grave errors, and has frequently led to the too early discontinuance of passive fixation, and to the premature re-commencement of movement. . . . He concludes by saying that artificial fixation, on the one hand, and natural fixation, on the other, are the two principal therapeutic agents in diseases of the joints; the one combats anatomical lesions, the other restores physiological action. We may assist the former by various means — local, pharmaceutic, or hygienic; we favor the second by electrization of the peri-articular muscles, practised during the period of fixation, with a view to the prevention of degenerescence."

The necessity for securing the beneficial effects of outdoor air, by means of some portative apparatus which removes pressure from the inflamed joint, is now so generally appreciated that we need not urge its importance.

The special methods of meeting the above indications will be described, when we consider the treatment of the diseases of particular joints.

HIP-JOINT DISEASE.

In 1835, William Harris, of Philadelphia, first demonstrated the value of extension and fixation of the joint, as *curative agents*, in the treatment of morbus coxarius, and, in 1839, he recorded, in one of the journals of that city, three cases treated by Hagedorn's long splint, formerly used in the treatment of fractures of the thigh. The suggestion of Harris was for a time overlooked, and we heard nothing more of extension, as a means of treating morbus coxarius, until Sir Benjamin Brodie again called attention to it, in the fifth edition of his work on diseases of the joints, published in 1850. Sir Benjamin recommended extension, in the advanced stage of the disease, after shortening had taken place, merely for the purpose of *overcoming deformity*, and not as a method of treatment adapted to all stages of the malady. His plan consisted in passing a band around the thigh, above the cardyles, to which a cord was attached; this was carried over a pulley, at the foot of the bed, and had a weight attached to it for the purpose of maintaining continuous extension. It was, indeed, virtually, what Dr. Davis subsequently called *elastic extension*. Dr. Alden March in 1853 (*Transactions of the Medical Society of the State of New York*), also advised extension, as a means of correcting

deformity, and, in 1855, Dr. Bauer, in a paper published in "The New-York Journal of Medicine," speaks, for the first time after Harris, of the beneficial effects of extension in relieving pain and controlling the disease, as well as in overcoming deformity. In 1855, Dr. H. G. Davis described a new portative apparatus, designed to produce extension, while allowing motion in the joint, and permitting the patient to enjoy the benefits of out-door exercise, so important in the treatment of this disease. He maintained that motion in the joint, at the same time that extension is made, is an indispensable part of the treatment, and his instrument was devised to meet these two indications. It was claimed, also, by Davis and his followers, that confinement to bed, with a long splint applied, fixing the joint, not only impaired the general health, but increased the risk of anchylosis, which would leave the patient in a worse condition than if left to the tender care of Nature herself. This new method of treatment awakened the interest of surgeons, generally; and very soon afterwards, Sayre improved or modified Davis's instrument, and, with the enthusiasm of an ardent nature, brought the new treatment prominently into notice, and, by published essays and lectures on the subject, did more to secure its general adoption than the originator himself had done. The instruments of Taylor, Vedder, Washburn, and that devised by myself, are also modifications of Davis's, designed to accomplish the same indications, viz.: *mobility of the joint with extension.*

Barwell, Andrews, of Chicago, Bauer, now of St. Louis, and Thomas, of Liverpool, believe that the indications for the proper treatment of the disease are, to secure *immobility of the joint with extension*, and they have respectively devised very ingenious instruments to accomplish this purpose; while Professor Hamilton's

wire-gauze apparatus, was designed merely to secure *immobility of the joint, without extension.*

All these appliances are well known in this country, except that of Thomas, of Liverpool, which I will briefly describe. It consists of a flat piece of malleable iron, from three-quarters of an inch, to an inch in width, by one-quarter in thickness, which extends from the lower angle of the shoulder of the affected side, in a perpendicular line, downwards, to the calf of the leg. A strap of hoop-iron is riveted to the top of the upright, and nearly encircles the body, a little below the axilla; another strap of iron, half the circumference of the thigh, is fastened to the upright, just below the fold of the buttock; and a third, half the circumference of the calf, is riveted to the lower extremity of the upright. The instrument is carefully moulded to the inequalities of the body, by means of wrenches, and is well padded and covered with leather. The apparatus having been applied, the patient is allowed to walk on crutches, with a patten on the sound foot, so as to elevate the diseased limb two or three inches from the ground.

This apparatus will not permit the patient to sit down, and renders defecation very inconvenient.

We have, therefore, three classes of portable appliances in use for the treatment of morbus coxarius, all of which, with due respect to the ingenuity of their respective authors, I feel called upon to condemn — (1) Because they do not achieve the objects for which they are designed. (2) If they did, they are unnecessarily cumbrous and uncomfortable, and therefore should be abandoned, because the same indications can be accomplished by a method simpler and more comfortable to the patient.

The notion that extension and motion are obtained by the

apparatus of Davis and his followers, is a great deception. If you notice a patient wearing either Taylor's or Sayre's long splint, which are modifications of Davis's, and most frequently used here, you will see, when he walks, that the whole pelvis swings, *and there is no motion at the hip-joint.* This immobilization of the joint, a kind Providence has secured, in spite of the efforts of the surgeon to prevent it. You will also observe that *there is no extension made by the instrument,* as the inventors claim, because the strap, which is designed to produce extension and passes from the ends of the adhesive plaster, beneath the extension-bar, is slackened at every step. This I have noticed lately in several cases, in one of the hospitals of the city of New York, in which there is a large orthopedic ward, under the care of an accomplished orthopedic surgeon, who uses Taylor's apparatus. The instrument merely transfers the weight of the body, from the hip-joint, to the perineal band, but the extension is made by the weight of the limb alone.

The apparatus of Andrews, Barwell and Bauer, are equally inefficient in securing the objects for which they were designed, viz.: to render the joint immovable, and to produce extension of the limb. Thomas's instrument, by its long leverage, extending from the angle of the scapula to the calf of the leg, has some control over the movements of the joint, but it is unnecessary for this purpose, and, as already indicated, is very inconvenient to the patient; while the wire-gauze apparatus of Professor Hamilton, can have but little influence in producing immobility, because it does not extend far enough above and below the joint.

Why is it then, it may be asked, if the appliances referred to are wholly inefficient to accomplish what is claimed for them, and are calculated to prove deceptive as to the results, that so much

improvement has been reported from them, when compared with others not having their features? For my own part, I am in the habit of explaining these favorable results by the fact that, the use of the instruments devised by American ingenuity, has liberated patients from confinement within-doors, and enabled them to live and move and exercise in the open air, instead of being treated in bed, as was formerly done; *and also from the fact that the principal indications, immobility and extension, are obtained in spite of the apparatus used.*

If fixation of the joint and extension of the limb, are essential conditions in the local treatment of morbus coxarius, and, to speak candidly, and yet deferentially, I believe these conditions are not secured by any of the appliances commonly used for this purpose, the question arises: How can these indications be adequately fulfilled with the smallest amount of discomfort to the patient and the least inconvenience to the surgeon?

The method of treatment which I have adopted, and used exclusively, for the last three years, and which has been used satisfactorily, by many skilled and reliable surgeons, here and elsewhere, is illustrated in Figs. 1 and 2. To the shoe of the sound limb, a steel plate, corresponding to the sole of the shoe, is attached, by upright rods two and a half or three inches in length, so as to raise the foot from the ground; — it is the shoe ordinarily used for shortened leg. This elevated shoe and a pair of crutches, constitute the apparatus. As the patient stands on his crutches, the diseased limb is suspended; the shoe should be high enough to prevent the toes of the affected side from touching the ground, and the sole covered with leather, to avoid noise when walking.

By these simple appliances, we meet all the indications for the

local treatment of hip-joint disease; and, I desire to emphasize the statement that, whatever artificial appliances for fixation and extension may be added, they only tend to increase the discomfort of the patient.

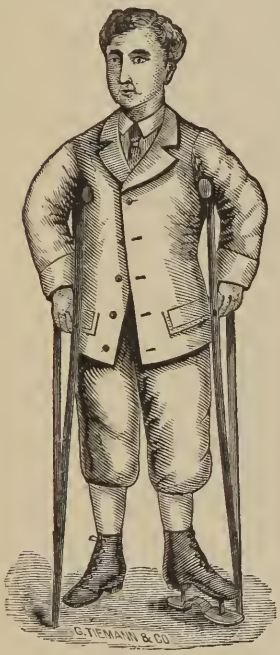

FIG. 1.

FIG. 2.

TO SECURE IMMOBILITY OF THE JOINT, NO APPARATUS IS NECESSARY.

Immobility, a condition so important in the treatment of inflammation of this, as of other joints, is secured by reflex contraction of the peri-articular muscles, aided by intra-capsular effusion, and by the voluntary effort of the patient to keep the joint at rest, on

account of the pain which motion produces. Fixation of the joint, is one of the earliest symptoms and is a characteristic condition of morbus coxarius; and it is so marked, that, when we move the limb, the pelvis moves with it — there is *apparent* anchylosis. This rigidity continues until Nature says that immobility is no longer necessary; but, so long as it is necessary, she secures it better than we can do by any artificial appliances. In the later stages of the disease, motion is desirable, and gradually, as the inflammation subsides, the muscles become relaxed, motion returns, and anchylosis is prevented, except in cases in which there is extensive destruction of the joint-surfaces, and then cure by anchylosis is the thing to be desired.

TO OBTAIN EXTENSION OF THE LIMB, NO APPARATUS IS REQUIRED.

Extension is made by the weight of the suspended limb, which is equal to one-fifth of the whole body, and is greater than the weight usually employed for extension. This is quite sufficient to subdue the spasm of the muscles which crowd the head of the bone into the inflamed acetabulum, and is the chief cause of the pain which the patient experiences. In a child weighing sixty pounds, for example, the weight of the limb would be about twelve and a half pounds, which is more than the child would bear by the ordinary method of extension by weight and pulley. We all know how promptly contraction of the muscles of the extremities, in case of cholera, or from other causes, is overcome by forcible extension. The pain in the part is relieved, not by separating the inflamed articular surfaces, as has been claimed, for we cannot separate them to an appreciable extent, by any amount of extension that can be applied. The extension not only relieves pain,

but it corrects the *malposition* of the limb, whatever it may be, and prevents the deformity which would otherwise occur, from contraction of the muscles or from partial dislocation of the head of the bone. By means of the elevated shoe and crutches, *the weight of the body is removed from the diseased joint, and the patient can enjoy all the benefits of open-air exercise*, conditions so evidently necessary as to require no special consideration.[1]

Experience has proved what Nature seems to indicate, that the method of extension here described, is more efficient and more agreeable to the diseased parts involved, because it is more gradual and uniform, and is less arbitrary and constraining, and, therefore, excites less reflex resistance than any other method hitherto employed. There is a certain instinctive, unconscious recoil, in the mind of every patient, young or old, against all the various devices of constraint or imprisonment, which a splint or apparatus implies.

This plan of treatment should be adopted at once, whatever the stage of the disease, and be continued until the cure is completed, except in the comparatively rare form of arthritic coxalgia, in which is suddenly developed an acute inflammation of the synovial membrane and other soft structures of the joint, attended with great constitutional disturbance and excruciating pain, which

[1] I have seen, quite recently, that Dr. Taylor, in a paper published in *The New York Medical Record*, September, 1867, says, that "Many have advised, as I sometimes have when circumstances were such that nothing better could be done, to wear a thick sole on the foot of the well leg, and use crutches, letting the lame leg hang." He seems not to have pursued the method successfully and satisfactorily, because, as he says, "the difficulty is in carrying the plan into practice with sufficient perseverance and uniformity." Dr. Sayre has also called my attention to the recommendation, in his work on Orthopedic Surgery, of similar appliances for the treatment of *sacro-iliac disease*.

is increased by the slightest movement of the limb or the shaking of the bed. In such cases, it would be inappropriate, at first. Until after the acute symptoms have subsided, such cases should be treated in bed, with the long splint and the weight and pulley, together with other appropriate remedies. *But in all other forms of the disease, in all its stages, whether the first, second or third, the method of treatment is appropriate*, if the patient is old enough and has sufficient strength to use the crutches. Mr. William Adams, of London, in a letter just received from him, says, "There can be no doubt whatever of the great value of your suggestion to put the raised boot on the sound leg, in hip-joint disease, and allow the patient to move about on crutches, but both the case and the stage must be selected." I am quite sure that a larger experience will satisfy my friend Mr. Adams, that the *physiological method* is applicable to all cases, except those I have mentioned.

There may be cases in which it will be necessary to make extension, at night, by the weight and pulley, to relieve the usual nocturnal pain, while the elevated shoe and crutches are used during the day; but I have not thus far met with any, even among those who had used the night-extension with some portative apparatus during the day, up to the time they came under my treatment, and there can be no stronger proof of the efficiency and the appropriateness of my method.

I have, however, found night-extension useful in cases in which the muscles are contracted, on account of the neglect of early treatment. In these cases, the weight and pulley, at night, in addition to the elevated shoe and crutches, during the day, enables us sooner to overcome the flexions of the limb. In such

cases, we may also derive benefit from adding a weight to the heel of the shoe of the diseased side, when the increased extension can be borne; but, my belief is, at present, that night-extension is unnecessary for the purpose of relieving pain.

The patient soon learns that relief from pain is obtained by suspending the diseased limb, and then he is glad to walk or to stand on the crutches, three or four hours daily. This appears to be sufficient to relax the muscles to such a degree that spasmodic contraction, with the accompanying pain, does not take place at night.

For children who are too young, and for older persons who are too feeble to use common crutches, Darrach's wheeled crutch (Fig. 3), or the ordinary go-cart, are admirable aids to locomotion. Darrach's crutch is the best, as it is so constructed that the patient may be partially suspended in the crutch, if necessary, by a perineal band, which prevents fatigue, and it is also lighter and more elegant in its construction. The elevated shoe should be used with either instrument. If a case comes under treatment at so advanced a stage that resection is necessary, the elevated shoe and crutches should be used, after the active symptoms following the operation have subsided, instead of adopt-

FIG. 3.

ing the usual practice of confining the patient to bed and using the weight and pulley.[1]

Since I first called attention to the physiological treatment of hip-joint disease, in the *American Journal of the Medical Sciences*, January, 1879, the method has been extensively used in several large hospitals, and evidences of its efficiency have been furnished me, from many private sources. To illustrate the advantages of this plan of treatment, I will narrate a few of the cases in which it has been used by myself and by other surgeons.

The following was the first case to which it was applied, and, for this reason, I reproduce it from the paper already referred to.

Case I. *Morbus Coxarius* (*second stage*), *treated by the Elevated Shoe and Crutches, Eight Months; Perfect Recovery.*— Ed. W., aged six years, a well-formed boy with good antecedents, was referred to me by Dr. George W. Baker, of this city. I saw him first, July 3, 1877, and obtained the following history: He fell from a sleigh seven months ago, and struck on his left hip. Soon afterwards, he had pain in the hip and knee, growing more severe at night. He had been in bed two weeks, with his thigh and leg flexed, and his mother noticed that whenever the limb was abducted during sleep, he was instantly awakened by pain. After spending two weeks in bed, the pain having diminished, he went about the house limping.

[1] Dr. Schenck, Medical Superintendent of the Kings County Hospital at Flatbush, uses a wooden substitute for the steel or iron patten, in the large institution under his charge. It consists of two pieces of wood, of the length and width of the shoe, separated from each other to a proper distance and connected by two upright pieces which project an inch or two above the upper horizontal piece before and behind, so that the foot cannot slip backwards or forwards. It is fastened to the shoe by straps and buckles like a skate, and answers every purpose of the steel instrument for hospital patients who do not walk upon pavements, and it costs nothing as it is manufactured by convalescent patients. Dr. Schenck informs me that he treats all his cases of hip-disease by the method I have described, with the most gratifying results.

When he came under my observation, he had pain in the knee, shooting upward toward the hip, growing much worse at night and when the weather was damp. The limb was abducted and apparently lengthened, the foot everted, the leg slightly flexed upon the thigh, and the thigh upon the trunk, partial obliteration of the gluteo-femoral fold; the peri-articular muscles were rigid, so that an attempt to move the joint moved the pelvis with it, as if anchylosis existed at the joint; striking the heel and the trochanter major, increased the pain in the joint, and, when laid upon the floor, the effort to bring the popliteal space in contact with it, produced a marked curve in the lumbar vertebræ. In short, he presented the symptoms of the second stage of morbus coxarius, in a marked degree. The elevated shoe and crutches were ordered, with open-air exercise and a proper regimen.

At the end of a fortnight, the pain had diminished, his aspect had improved, and he bore pressure over the trochanter much better. I saw him from time to time, and noticed a steady improvement.

March 6, 1878. — He has had no pain for a long time: all the motions of the joint are as perfect in one leg as in the other, except that the diseased leg cannot be so completely flexed upon the trunk, as the well one. As a precautionary measure he was directed to continue the use of the elevated shoe and crutches, for the present.

July 4. — Two or three weeks since, he dispensed with shoe and crutches, by my direction. All the motions of the joint are perfect and painless; he walks as well as he ever did; no pain developed on pressure about the hip, slight atrophy of the limb, no deformity; is well nourished, bright and cheerful, and,

as a pugilist, holds his own with any boy of his age, in the neighhood. I present this case as an example of the best cure of hip-joint disease I have ever seen.

Case II. *Morbus Coxarius* (*third stage*), *treated with the Elevated Shoe and Crutches, for Eight Months; Complete Recovery.* Notes by A. R. Paine, M.D. — Richard V., aged six years, was brought to the Brooklyn Orthopedic Infirmary for treatment, Feb. 12, 1878. His mother stated that, about one year ago, he fell down stairs, striking on his left hip. Disease in the joint soon followed, for which he was treated with electricity, and wore a modification of Davis's splint. The limb is now adducted, slightly flexed at the hip-joint, and the foot is inverted, resting with the ball upon the opposite instep; the gluteo-femoral fold is obliterated; there is considerable pain in the hip, increased by pressure over the trochanter, great pain in the knee and swelling behind the joint. He is also very anæmic.

Davis's apparatus was discontinued; he was directed to use an elevated shoe, two and three-fourths inches in height, and crutches, and to be in the open air at least three or four hours daily. He was also ordered cod-liver oil and iron.

March 12. — He has been much more comfortable since the elevated shoe and crutches were substituted for the apparatus previously used. His appearance has improved, and he has no pain. His mother has continued to use Davis's apparatus at night, lest the nocturnal pains might return. She was told that it was unnecessary, and directed to discontinue it.

April 5. — His general health is very good; no pain even when considerable flexion and rotation are made. His mother left off the night apparatus as directed; says that he has no

nocturnal pain, and sleeps as well without the apparatus as he did with it.

Oct. 29. — The position of the limb and foot is perfectly normal, no shortening; the joint moves freely in all directions without pain; the most careful examination shows no evidence of disease, and he looks and feels well. He is directed to continue the use of the elevated shoe and crutches for some time longer, as a precautionary measure, although I now consider the case one of perfect recovery.

This little patient was shown to the members of the Medical Society of the County of Kings, at the April meeting, 1879. He had not used the crutches and shoe for some months previously, and his recovery was pronounced complete.

Case II. *Morbus Coxarius* (*third stage*), *treated with the Elevated Shoe and Crutches; Recovery after less than five months' treatment.* — Fred. R., three years old, was brought to the Orthopedic Infirmary Feb. 14, 1879, and the record of his case was made by Dr. H. W. Rand.

The parents think the present trouble commenced when the child was six months old. He is tolerably well nourished, and gives no history of injury. When he began to creep, it was noticed that he favored the right leg. Two months later, swelling appeared around the hip-joint, most prominent in the groin, where it was opened by the family physician, and discharged a thin yellowish fluid.

Since the child began to walk, he has always borne the most weight on the ball of the foot, rarely allowing the heel to touch the floor, owing to flexion of the thigh on the trunk. He complained of very little pain, until Dec. 11 of last year, since which time pain has been almost constant and referred to the hip-joint.

When presented at the Infirmary, the thigh was flexed on the abdomen, the foot inverted, the pelvis drawn up, on the affected side, the nates flattened, and the gluteo-femoral crease lowered. Movement of the thigh excited spasmodic action in all the muscles around the joint, presenting apparent anchylosis of the hip-joint, the pelvis moving with the femur. Pressure of the head of the femur against the acetabulum and pressure behind the trochanter, caused pain.

Ordered elevated shoe ($2\frac{1}{2}$ inches) for left foot, and crutches.

Patient returned March 4. Has learned to walk with the crutches, and has had no pain for the past week. When seen, March 11, he was still entirely free from pain, movement excited less spasmodic action in the muscles around the joint, and the flexion of the thigh on the abdomen had somewhat diminished.

July 8. — All tenderness and pain about the joint have disappeared, the limb is straight, there is still some rigidity of the joint. The shoe and crutches were dispensed with. This patient was found six months after treatment was discontinued, and carefully examined by Dr. W. M. Thallon, who furnished the following note. "The boy has continued quite well and has very good use of the leg. Except on very close examination, the previous existence of morbus coxarius, would not be suspected."

A point of interest in the case is, the early age (three years), at which children may be taught to use the elevated shoe and crutches. This patient was also presented at a meeting of the Medical Society of the County of Kings.

The notes of the following three cases, were kindly furnished me by Dr. C. E. Fritts, of Hudson, N.Y.

Case IV. *Morbus Coxarius, treated with the Elevated Shoe*

and Crutches, for five months and a half; Recovery complete.— "I. D. H., aged ten years, first consulted me, May 22, 1879. He complained of severe pain in the right hip-joint and lameness, which began one month before; these symptoms were growing steadily worse, the foot was inverted, there was fulness of the gluteal region, the gluteal fold was partially obliterated, the thigh was flexed somewhat upon the pelvis, reflex contraction of the muscles around the joint produced apparent anchylosis, any attempt to move the joint caused him great pain, pain was also produced when the trochanter was pressed inward, and when the heel was struck.

"He was put to bed and kept quiet for one week, during which time I had the elevated shoe, advised by Dr. Hutchison, made for him, and he was put upon it, with the crutches, May 30. On the same day, he was seen by Dr. Vanderveer, Professor of Surgery in the Albany Medical College, who concurred in the diagnosis and treatment.

"After using the shoe and crutches for two weeks, all pain in the joint passed away. The patient wore the shoe and crutches for five months, when the shoe was laid aside, and he used the crutches alone for a couple of weeks longer, touching the right foot, lightly at first, but afterwards bearing equal weight on both feet. The crutches were now thrown aside, and he was allowed to walk without any artificial support.

"An examination, five and one-half months after treatment was begun, shows that the position of the limb and foot is normal, there is no shortening, the joint moves freely in all directions, without pain, there is no evidence of any joint trouble whatever, and I consider him perfectly and entirely recovered." Dr. Fritts

writes, April 8, "This boy has not used a crutch or worn his elevated shoe since Jan. 1, 1880."

Case V. *Morbus Coxarius (third stage); Abscesses from Diseased Bone; Recovers.* — "This patient was a boy seven years old, who began to complain of pain in his right hip, one year before I saw him, ascribed to jumping some time previously. There is no evidence of a constitutional taint of any kind.

"On examining the limb, I found the thigh flexed on the pelvis and adducted, and the foot inverted; there was considerable swelling behind the joint, with fluctuation and an abscess subsequently opened behind from under the gluteal muscles, and another, on the outer aspect of the thigh, below the tensor vaginæ femoris. There was but little motion in the joint, and pressure upon the joint, or motion, caused great pain. The pain was worse at night. He was put upon the elevated shoe and crutches, June 1, 1879. He was very soon relieved of all pain, and his general condition began at once to improve."

Dr. Fritts writes, April 8, 1880, "The present condition of this boy is excellent, the sinus have all closed, the eschars adherent to the bone; there is quite free movement of the joint, without the slightest pain; he bears his weight upon the limb without inconvenience, has gained flesh and is hearty and robust. Before using the high shoe and crutches, he was carried about in his nurse's arms, was very much emaciated, and his relatives were expecting him to die soon."

Case VI. *Morbus Coxarius (third stage); Abscesses from Diseased Bone; treated with Elevated Shoe and Crutches; Recovery.* — "A girl, aged nine years, came under my observation, June 1, 1879, with disease of the right hip-joint of three years standing.

There was no history of injury and no constitutional taint. There were three fistulous openings discharging pus, — one in front of the joint, one on the outer part of the thigh and one behind the joint; the thigh was flexed upon the pelvis, adducted, and the foot was inverted; there was little or no motion in the joint, and any effort to move it, and pressure over the trochanter, caused great pain; the pain was not worse at night. She had used, for a long time, a modification of Davis's splint. She was put at once upon the elevated shoe and crutches advised by Dr. Hutchison, and the local symptoms and general condition began to improve in a very short time."

In a letter dated April 8, 1880, the reporter says, "The present condition of this patient is remarkably good; all the abscesses and sinuses have healed; eschars adherent to bone; there is but little shortening; good motion in the joint and only a slight limp in walking."

The notes of the following case were kindly furnished by Dr. C. L. Squire, of Elmira, N.Y.

Case VII. *Morbus Coxarius* (*third stage*); *Abscesses; Progressive Improvement.* — "The patient, a boy ten years old, fell upon the ice Dec. 30, 1878, striking upon his left hip, and was taken home on a sled by his companions. Within ten days, symptoms of trouble with his hip showed themselves. The boy was healthy and his family history excellent.

"I saw him first, March 2, 1879, two months after the injury; he then exhibited marked symptoms of morbus coxarius. The thigh was flexed upon the pelvis and adducted; the foot was inverted; there was marked swelling about the joint; the gluteo-femoral fold was lowered and partially obliterated; motion of the joint and

crowding the head of the femur into the acetabulum increased the pain; the pain was much worse at night. He also had necrosis of the left tibia. He was put upon sodium salicylate (Squibbs'), which was followed by complete relief of pain except when motion or pressure were made.

"On March 31, he began the use of the high shoe and crutches with great relief to his local symptoms. During the month of September an abscess formed and opened just below the trochanter."

April 1, 1880. — "My patient has been doing remarkably well since the last report. He still wears the elevated shoe, and is in the streets, with the crutches, a good share of the time. There is a fistulous opening just below the trochanter which is discharging moderately. . . . The necrosis and exfoliation of the opposite tibia, has been a serious complication, but even with this additional difficulty, the elevated shoe has been of the greatest advantage to him, allowing him to take healthful exercise in the open air. His appetite is excellent, he is free from pain, sleeps well, and is decidedly improving in every sense."

The above cases are taken, without selection, from among those which have terminated or are approaching recovery; incomplete cases are unsatisfactory. I have preferred also to give cases which were treated by other surgeons, and were reported by them: this is true of all the above cases except the first, the second and the third which were treated at the infirmary which is under my supervision; the remainder, I have never seen, but the reliability of the reports and the reporters cannot be questioned. I think it is not too much to say that they show better, more rapid and more useful results, obtained by the "physiological

method," than by the older methods of treatment, and I am sure with less annoyance and discomfort both to the patient and to the surgeon.

The simplicity of the method, enables the general practitioner to conduct the treatment of such cases without the aid of a "specialist," or the professional instrument-maker.

I do not wish to underrate the service which has been rendered to orthopedic surgery by specialists, but, I simply protest against the prevalent idea, that diseases and deformities of the limbs and other parts of the body, can be properly treated only by an orthopedist, or in an orthopedic hospital.

As an evidence that general practitioners of medicine and surgery, are, since I called attention to the physiological treatment of hip-disease, treating such cases themselves, I may state that, whereas I formerly had a good many private patients of this class sent to me for treatment, the number has diminished. Metaphorically speaking, "Othello's occupation's gone."

Every surgeon of experience, has met with cases in which it was impossible to apply any kind of portative apparatus to the diseased limb, on account of abscesses and fistulous openings about the joint. The only alternative in those cases has been, confinement to bed, with the weight and pulley, in order to prevent deformity and pain, thereby depriving the patient of the benefits of open-air exercise, so important in the treatment of this class of cases. I recall several cases that have terminated fatally, and others that have required resection, whose lives, in the former class, I now believe, might have been saved, and in the other, cures might have been effected without operation, if they had enjoyed the advantages of fresh air, on the high shoe and crutches.

What a boon it is to get rid of the paraphernalia with which the diseased limb was formerly encumbered, — the harness and the trappings, the weight and pulleys and the adhesive plaster, the perineal bands and the iron splints, and all the discomforts which their use implies !

THE KNEE-JOINT.

From the diseases of the hip-joint, we will descend to those of the knee ; but, we must take the metaphor, as Mr. Solly says, in an anatomical, not in a surgical sense ; for the frequency with which inflammation occurs in the knee-joint, owing to its complicated mechanical machinery and its exposed position, both in relation to atmospheric changes and its liability to receive injury from violence, invests the subject with an interest to the surgeon quite as great, if not greater, than that which pertains to the hip-joint.

In morbid conditions of the knee-joint, the indications for treatment are, in all respects, the same as in inflammation of the hip-joint, with the addition of *compression* over the joint.

The knee is not, like the hip, surrounded with powerful muscles, which, by their rigidity, immobilize the diseased hip-joint. It is necessary, therefore, in the case of the knee, to bring to our aid some mechanical restraint, in order to secure complete rest. To cause *fixation* of the knee-joint, I use splints made of hatter's felt, such as is shown in Fig. 4. It consists of seven layers of thin muslin each saturated with shellac, and well rolled together, while hot. It is manufactured, of this thickness, specially for me, by Mr. Holley, of South Fifth Avenue, New York, and may be obtained from Tiemann, and, I suppose, from other surgical-instrument makers. That ordinarily sold consists of but five layers of

cloth, which, for most cases, is not firm enough. To give complete rest to the joint, the splint should extend half-way up the thigh, and to a corresponding point below the knee, and should be wide enough to nearly surround the limb (Fig. 4). A splint shorter than this, and merely wide enough to cover the posterior part of the limb, does not secure the complete immobility which I have insisted upon in the treatment of diseases of the joints, when absolute rest is demanded. The splint having been cut of the proper length and width, which may be easily done with a sharp knife, the limb is covered with a stocking, and the felt, made pliable, preferably by dry heat in an oven or before an open fire, or by immersion in very hot water, is applied to the limb, and covered quickly and firmly with a bandage from below upwards, so as to mould it to all the inequalities of the surface. While the splint is being applied, an assistant should make extension from the foot, so as to straighten the limb as much as possible, in cases where the joint is flexed; but no violent effort should be made to reduce the malposition; this can usually be accomplished by the gradual, painless (physiological) extension made by the weight of the limb, to which we shall presently refer. The surfaces of the joints are morbidly sensitive to pain, which would be greatly increased, if they were suddenly and forcibly pressed together, in the effort to reduce the deformity at once. If the surgeon's hands are very sensitive to heat, he may handle the splint better by wearing a pair of cotton gloves, wet in tepid or moderately cold water.

FIG. 4.

So soon as the splint regains its inflexibility, and this it does very quickly, it may be removed, trimmed up and holes punched in it, an inch, or an inch and a half, from the front edges, for lacings. The object in punching the holes a little way back from the edges, is to permit the splint to be made smaller, by cutting off the edges, so that pressure may be kept up, as the knee diminishes in size. The splint should nearly meet in front, and be laced as tightly as the patient can bear it, with comfort; all the benefits of elastic pressure may be secured, by surrounding the knee with a layer of wool wadding, which never becomes matted, never loses its elasticity, and is an extremely comfortable method of making pressure, if the patient should complain of discomfort from the splint. If, in any case, it is considered desirable to leave the top of the knee uncovered, a semicircular piece may be removed from either side of the splint, and windows may be cut, at any point, where there are fistulous openings which require dressing. The splint may be made more comfortable in warm weather, by perforating it, here and there, with a punch. If the leg is rotated on its longitudinal axis, with a tendency to inversion or eversion of the foot, this should be prevented by extending the splint down to the foot.

If the leg is flexed, when the splint is first applied, and cannot easily be forced into a straight position, the angle of the splint should be changed, from time to time, as the leg becomes straighter, under the influence of extension by its own weight. This may be done by softening the posterior part of the splint, by the application of a sponge dipped in hot water; a bandage should then be firmly applied, while extension is made upon the leg, by the hands of an assistant. So soon as the splint hardens, the bandage is removed and the lacings tightened. The splint, although firmly

applied, does not interfere with the straightening of the joint, by the extension made by the weight of the leg.

I prefer the felt splint to one made of plaster of Paris, leather or liquid glass, because, while it is equally firm, it is also lighter, may be equally well adapted to the inequalities of surface about the knee, is more easily applied, its angle may be changed without removing it from the knee, and it may be unlaced and opened, to examine the parts, or it may be removed, without disturbing the joint.

By means of the knee splint, we not only fix the joint and contribute to correct its malposition, but we also make *compression* upon the part, which is a valuable therapeutic auxiliary in the management of these cases, and its importance must not be overlooked. Compression causes absorption of non-purulent effusions into the joint, removes the boggy, infiltrated condition of the connective tissue which surrounds it, protects the part, and gives support to the relaxed ligaments and the synovial membrane.

Extension is best accomplished by the use of the elevated shoe and crutches, which have already been described, in considering the treatment of hip-joint disease (Figs. 1 and 2). The weight of the suspended leg, which may be estimated as one-twelfth to one-tenth of the weight of the body, eight to ten pounds, in a body weighing one hundred pounds, is quite sufficient to tire out the muscles, which, by reflex contraction, compress the already suffering tissues within the joint, increasing the pain and leading to interstitial absorption — in short, the muscles are restored to their normal length. By means of extension, we also correct the malposition of the limb, which is usually contracted

to an angle of a hundred and twenty degrees; but extension has not the slightest influence in separating the diseased articular surfaces, which, however, I do not consider necessary. This method of extension is so gradual and uniform, and therefore so soothing to the diseased parts, that the muscles are enticed to relax, if such an expression is permissible in this connection, instead of being irritated and stimulated to contraction.

The apparatus of Professor Sayre, for producing extension of the diseased knee-joint, as well as the appliances of H. G. Davis, and Sherman, of Chicago, for the same purpose, are creditable to the inventive genius of their respective authors; but, those who have used either of them, must be aware of the skill and experience necessary to apply them properly, the constant attention they require to keep them suitably adjusted, and the discomfort to the patient, produced by the irritating effects of the adhesive plaster with which they are all attached to the limb. Moreover, the effort to produce forcible extension by these various devices, excites reflex resistance, and the patient, young or old, instinctively recoils from the attempt to overcome muscular contraction by an exertion of strength, applied by means of an apparatus.

The weight of the body being removed from the diseased joint, by the use of the elevated shoe and crutches, the patient should be kept out of doors as much as practicable, and if old enough to understand the *rationale* of the treatment, the importance of using the crutches three or four hours daily, should be explained to him, and, if necessary, their employment enforced. Patients should also understand the importance of keeping the joint at rest. They not infrequently complain of the restraint of the splint, and secretly remove it themselves; and this is especially

true of dispensary patients, not because they really suffer pain from the position or the confinement of the limb, but because they are afraid of losing the use of the joint. I mention this, not to induce you to shut your ears or disregard the complaints of patients — on the contrary, I think they always deserve attention — but to warn you against being deceived by such persons.

There are many mild cases of chronic inflammation of the knee-joint, characterized by slight effusion into the joint, and tenderness on pressure over the lower part of the inner condyle of the femur, or at the inside of the head of the tibia, in which there is no pain on pressing the articular surfaces together. In such cases, the application of the knee splint is sufficient to effect a cure, without the use of the elevated shoe and crutches.

When the disease has resulted in destruction of the joint and caries, either from the violence of the attack, or from the advanced stage of the disease when it came under observation, we may still hope to save the limb and effect a cure by anchylosis. In fact, by rigidly carrying out the indications above referred to, of which the first in importance, in all joint inflammations, is perfect immobility of the part, the most unpromising cases, not infrequently recover; but, if the patient is becoming exhausted by suppuration, and there is not sufficient recuperative power left to throw off the disease, resection or amputation may become necessary.

THE ANKLE-JOINT.

In the treatment of inflammation of the ankle-joint and its consequences, *perfect rest* of the parts by mechanical means, and the *removal of pressure* from the diseased articular surfaces, is quite

as important, and, I may add, quite as satisfactory, as in diseases of the hip and knee, and the indications may be met in the same way. Instead of the felt, I prefer to use, for fixing the ankle, two splints made of plaster of Paris, because they are more easily adapted to the inequalities of the surface about this joint; one is to be applied in front, and the other behind, extending from the middle of the leg to the ends of the metatarsal bones, and wide enough to leave an interval of half an inch between the edges, on the inner and the outer side. The splint should be made of two layers of Canton flannel, of coarse texture, or of three layers of coarse towelling, cut of the proper length and width. One layer of cloth is laid upon a table and covered with liquid plaster, of the consistence of cream and spread smoothly, with a table-knife. The other layers are then immersed in the plaster and applied evenly and smoothly over the first; and when both splints have been prepared, one is applied in front and the other behind, with the under surface of the first layer, which is not covered with plaster, next to the skin, and a roller bandage is firmly applied over the splints, from below upwards. The surgeon should now grasp the foot, and, holding it at a right angle with the leg, make extension until the plaster hardens, which requires about five minutes. The bandage should then be removed, and the splints, surrounded by three or four strips of adhesive plaster, and the bandage re-applied more loosely. Windows may be cut in the plaster, so as to allow any openings that may exist in the parts, to be uncovered (Fig. 5).

In all cases of diseased ankle-joint, the heel is raised more or less, by the contraction of the gastrocnemii, if it is permitted to pursue its own course, and the toes point downwards, and in such

cases it is important to overcome the contraction of the muscles, and place the joint at rest, with the foot in its normal relation to the leg, in order to secure its proper position, should anchylosis take place; and to relieve the pain produced both day and night, by the unremitting muscular contraction.

FIG. 5.

To remove pressure from an inflamed ankle-joint and to provide means for letting the patient get the benefits of the open air, is not less important than in the case of a diseased hip or knee joint. To accomplish these essential indications, a variety of instruments have been devised. But they are liable to the same objections which have been found to the appliances used for producing extension of the knee-joint. After an experience, somewhat extended, in the treatment of these affections, I have no hesitation in recommending the elevated shoe and crutches, as the best and simplest method of making extension and removing pressure; it is just as effectual for the ankle as for the knee and hip joints. The weight required is not great, and the weight of the foot is sufficient to overcome the muscular contraction.

If the foot, from long neglect, cannot at once be brought to a right angle with the leg, the splints should be renewed every five or six days, and the extension increased a little at each application, until the foot is brought into proper relations with the leg.

The advantages which the treatment here described possesses over that commonly employed, in the management of chronic inflammation of the joints of the lower extremities, are : —

1. It saves the surgeon the trouble and annoyance of applying and carefully watching the instruments in ordinary use, to see that proper extension is kept up, and undue pressure prevented : while the patient's comfort is greatly promoted by dispensing with adhesive plasters, which irritate the skin and require removal from time to time, and by discarding the perineal band, in hip-disease, which is a constant source of discomfort.

2. The spasmodic contraction of the peri-articular muscles is overcome by the gentle, persuasive and painless (physiological) extension, made by the weight of the limb, for several hours each day, whilst forcible extension, either by the ordinary portative instruments or by the weight and pulley, irritates the muscles and stimulates them to resistance and contraction, both of which must be overcome by main force.

3. I am quite confident, judging from the experience thus far obtained, that the plan of managing diseases of the joints here described, will shorten their duration more decidedly than can be done by the older methods of treatment.

4. The apparatus — if so simple a thing deserves the name of apparatus — is inexpensive, and can be made by any ordinary mechanic.

It is with a just deference to established usages that I ventured to condemn as useless or hurtful, the appliances hitherto in use, in the treatment of diseases of the hip, knee and ankle joints, and to commend to professional notice new and simpler methods. I should not have had the temerity to do so, had not my convic-

tions, based upon practical experience, seemed so plainly to warrant the positions I have endeavored to maintain. These convictions have been strengthened, also, by the favorable opinions expressed of the treatment of hip-joint disease, by this method, since the publication of my paper upon the subject, by many surgeons in this country and abroad, for whose judgment I have long been accustomed to entertain the highest respect.

ON CLUB-FOOT:

ITS CAUSES, PATHOLOGY, AND TREATMENT.

CLUB-FOOT.

CHAPTER I.

INTRODUCTORY AND HISTORICAL REMARKS. — RE-UNION OF TENDONS AFTER SUBCUTANEOUS TENOTOMY, AND RULES FOR THE OPERATION. — RATE OF EXTENSION AFTER TENOTOMY. — DIFFERENCE IN THE NORMAL ANATOMY OF THE INFANT AND THE ADULT FOOT. — VARIETIES OF CLUB-FOOT. — CONGENITAL AND NON-CONGENITAL TALIPES. — CAUSES. — PROGNOSIS.

GENTLEMEN, — In a special course of lectures, which I have been appointed to deliver in this institution,[1] I desire to call your attention to the surgical treatment of that class of deformities or malformations, which is commonly expressed by the term, club-foot. In doing so, I shall open to you a much-neglected, but, humanely speaking, one of the most attractive chapters of modern surgery. I say "modern surgery," purposely, for it is important for you, on many accounts, to know that this department of orthopedic surgery, as well as some others which will be mentioned by other instructors, is much younger than the present century. Our older surgeons readily recollect the modest begin-

[1] The College of Physicians and Surgeons, New York.

nings of their practice in the division of tendons, and even those who do not consider themselves old, well remember to have seen deformed persons, who, through a long life, have borne without hope, the miseries attendant on unrelieved club-foot which, in earlier years, might easily have been cured. It was not until 1816, that the eminent surgeon, Delpech, began this procedure with hesitation and with indifferent success. In this connection I will ask you to fix in your memory, as one of the pioneers of your art, the name of this surgeon of Montpellier, who, if he had lived out the ordinary span of life, would have left a name, not easily forgotten, for originality of thought and ingenuity of execution. As it was, he left a book, "De l'Orthomorphie," printed in 1828, which contains statements of principles, and rules for practice that are quoted by every systematic writer on this subject, down to the present day. His four rules for subcutaneous tenotomy, somewhat modified by the progress since made, are followed by the orthopedic surgeons of to-day. It is true that, before Delpech's time, tendons had occasionally been divided by veterinary surgeons, as well as for the relief of club-foot, but not subcutaneously, so that it was reserved for that surgeon to give to the operation, a recognized and legitimate place in surgery. In 1831, Stromeyer, of Hanover, improved upon Delpech's method by the use of a small bistoury, thus avoiding the danger of a large external wound. Stromeyer's cases, too, were almost uniformly successful; so that, with the publication of his experience in 1834, tenotomy may be said to have gained a footing on solid ground. Tenotomy therefore, you will observe, has not quite completed its first half-century. After Stromeyer, the operation was rapidly adopted by the best surgeons of Europe and America; by some,

improved and simplified, principally (1) by the adoption of the rule; that the section should be subcutaneous, that is to say, the surgeon avoids a counter-opening on the further side of the subsected tendon, while making as small an incision as possible at the point of entry of the narrow-bladed knife, and (2) by making the incision in a valvular form, i.e., the integument is slid somewhat to one side, as the knife is entered, so that, when it is withdrawn, the wound through the skin does not exactly correspond with that in the deeper parts. This step, it is believed, tends to prevent the admission of air into the inner wound, thereby avoiding some of the chances of inflammation and suppuration which may follow the presence of air in the deeper tissues, and interfere with the proper union of the tendon. I will not, now, demonstrate the manner in which the operation of tenotomy is ordinarily performed, because I shall have occasion to do so at a future time.

In this country, the tendo Achillis was first divided, according to the Stromeyerian method, by the late Dr. James H. Dickson, in 1835. Thus you may learn how slowly came the recognition of this valuable operation, which already has been performed many thousands of times. It is a simple operation, easy of performance, comparatively free from danger, from loss of blood and from any disagreeable after-effects. It causes but little pain, and generally brings about a cure after a short period of confinement.

RULES FOR THE PERFORMANCE OF SUBCUTANEOUS TENOTOMY.

Let us now see what takes place when a tendon is thus cut, and how tendons re-unite. But, first, I will describe the manner in which the operation of tenotomy is ordinarily performed. The

limb should be so held that the tendon to be divided is made to stand out prominently; the skin is slid to one side, and the tenotome is carried beneath the tendon, flatwise; the cutting edge is now turned towards the tendon, which is to be divided transversely towards the skin, by alternately raising and depressing the handle, without puncturing the skin on the opposite side. After a tendon has been divided, pressure should be made along the track of the instrument, as it is withdrawn, in order to exclude the air and prevent extravasation of blood into the subcutaneous tissues. The wound should be immediately closed by a compress of lint, retained in position by a strip of adhesive plaster, and a "figure-of-eight" bandage, around the foot and ankle. The foot should then be put into a plaster-of-Paris or a felt splint, which has been accurately moulded to it before the operation, in the manner I shall hereafter show you. It is thus kept at rest, in the deformed position, until the puncture has healed, which usually requires about four days. To straighten the foot immediately after the operation, would tear open the wound, and most likely bring on suppuration. On the other hand, if we wait too long, we lose all the advantages to be expected from tenotomy. When, however, tenotomy is limited to the tendo Achillis, which has no synovial sheath, and therefore suppuration and non-union are not so likely to occur, the deformity of the foot may be rectified to a considerable extent at once and retained in the improved position by appropriate appliances.

The tenotomy knife should have the shape of the ordinary blunt tenotome, the extremity being sharp, instead of blunt. With this instrument, there is less danger of making a second puncture than with the more pointed instrument

RE-UNION OF TENDONS AFTER SUBCUTANEOUS TENOTOMY.

When the tenotomy is properly performed, the sheath of the tendon commonly remains intact, except at the point at which the knife enters. The tendon itself is, however, completely cut across, and the divided structure retracts: the one end separates from the other. The amount of retraction will, of course, vary considerably according to the size and power of the muscle, the degree of deformity to be overcome, or the amount of forcible motion that may then or later, be made at the joint. Taking the tendo Achillis for an example, the retraction is ordinarily from one-half an inch to one inch, in children, and one to two inches, in adults. The tendon is a very slightly vascular tissue, hence there is but little, if any, effusion of blood within the sheath, after tenotomy. It is the exception rather than the rule, for even the largest tendons to bleed, appreciably. Mr. Broadhurst, who has made numerous experiments for the purpose of studying the progress of re-union, says that on the second day "a small and unimportant film of blood was found in the sheath, and a small quantity of lymph was attached to the divided end." Billroth is nearly the only writer who makes mention of hemorrhage, and he merely says that it *may* be sufficiently abundant to hinder, and even prevent, the process of re-union. The space between the ends is filled by the effusion of a grayish lymph. This exudes from both ends, but more abundantly from the upper end. On the fourth day, the two ends are joined by means of this soft lymph. On the sixth day, it becomes a well-defined, firm, and ruddy cord, and has assumed a distinctly fibrous character. This is the beginning of a process of repair, which, in the end, forms a structure

that is histologically identical with that of the original tendon. (*Paget.*) As the repair advances, the tissue increases in quantity; it hardens and matures, loses its plastic and cellular quality, and takes on a new and more fibrous character, and, after a few months, it assumes almost exactly the appearance of the old tendon. The microscope is then unable to discriminate between the old and the new. The gross appearances are very nearly the same as to outline, surface, size, and strength; only in color is a difference recognizable. The new tendon is more grayish in hue, and has a less pearly lustre, than the original.

RATE OF EXTENSION AFTER TENOTOMY.

Although this new material is soft at first, it rapidly strengthens, so that in from thirteen to twenty days it becomes sufficiently strong to sustain the weight of many pounds. It is susceptible of extension to any degree required for the relief of deformity, even for weeks. On this account it is well not to undertake, too rapidly, the removal of extreme deformities; but it is wiser, in certain cases, to continue a gradual extension during a period of from two to three weeks, or even longer, in paralytic cases, and in persons of feeble health. It should be remembered, and I desire to emphasize this point, that force may be prematurely applied in such a way as to ruin the result, by causing the ends of the tendons to be drawn so far apart as to render re-union impossible. This was done when the operation was less understood. In such a case, a deformity, the opposite to that already existing, is produced. It is not sufficient simply to remove the malposition caused by a shortened tendon or muscle. The restoration of function must be held in view, and, of course, all power to do

this is lost, if an important muscle is permanently severed from its point of insertion. Rest, after tenotomy, should be allowed the limb for a period of from four to six days, rather longer in adults than in infants. Extension of the newly-forming band or bands of connecting tissue, should then begin gradually. Immediate extension has been recommended, but, for reasons already given, gradual extension, covering a period of two or three weeks, appears to offer the best prospects of success. The deposit of new material will thus be held under control, and the new tendon will not be put unduly on the stretch. Mr. William Adams advises that, in the atrophied limbs of paralytic patients, the efforts at restoration to a normal position be continued, little by little, for not less than five or six weeks.

DIFFERENCE IN THE NORMAL ANATOMY OF THE INFANT AND THE ADULT FOOT.

In order that we may understand the physiology and the pathological anatomy of the child's foot, it is important for us to study its normal anatomy, which differs materially from that of the adult. It is all the more important to direct your attention to this matter, because the text-books, as well as the lectures on orthopedic surgery hitherto published, are silent upon this subject. The plates and the descriptions of the foot which they contain, relate only to the adult foot. With the exception of the pelvis and the pelvic organs at puberty, there is no part of the body that undergoes greater anatomical and physiological changes than the human foot, from birth until the eighth year. A comparison of the foot of the child with that of the adult is therefore important.

The foot comprises all that part of the lower extremity situated

below the tibio-tarsal articulation. The orthopedic surgeon is principally interested in the superior and inferior surfaces, as a deviation from their normal outline, marks the degree and the direction of the deformity. The adult foot is in the form of an arch, convex above and concave below. The superior surface at its highest point, formed by the astragalus, receives the whole weight of the body, transmitted to it through the tibia and ankle-joint. The inferior surface transmits the weight to the ground. The convex form of the superior surface, gives great freedom to the movements of the leg, and, in connection with the marked

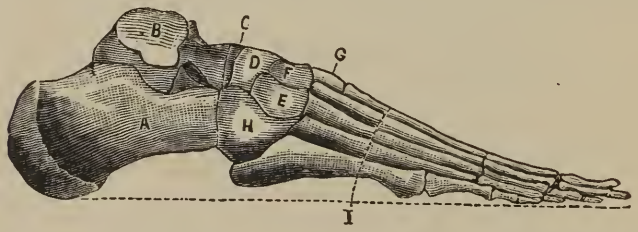

FIG. 1. Foot of adult: A, os calcis; B, astragalus; C, transverse tarsal joint; D, scaphoid; E, external cuneiform; F, middle cuneiform; G, internal cuneiform; H, cuboid; I, metatarsal bones.

flexibility of the organ, admits of great changes in the direction of its long axis, and in the position and direction of the centre of gravity; while the concave form of the inferior surface and the number of bones that enter into its formation, give it flexibility and strength, allowing it to accommodate itself to all the irregularities of surface with which it is brought in contact. The inferior surface is also marked by a double arch; the first and most important, extends from the heel to the ball of the great and little toes; the second, extending laterally, is formed by the scaphoid, cuboid, and cuneiform bones, and reaches to the tarsal extremities of the

metatarsal bones (Fig. 1). The points of pressure, when the foot is applied to the ground, are the posterior inferior extremities of the os calcis and the anterior inferior extremities of the metatarsal bones of the great and little toes.

In the infant, the conditions are very different. The inferior surface of the foot is flat, or nearly so, the arch hardly perceptible (Fig. 2). The convexity of the superior surface is scarcely marked, for the tissues are soft and abundant and adapted to bring to it the greatest amount of nutrition. At birth, and for some time subsequently, the feet are adducted and turned inward, so that their inferior surfaces look towards each other, and the inner ankle is scarcely observable. This condition continues during the movements of flexion and extension, and if we attempt to place the child on its feet, the outer border first touches the ground. This is not a deformity; it is a normal condition that changes with development. The feet are now unfit to support the weight of the body, as they are not yet sufficiently developed for that purpose. The bones that are destined to become solid and firm, are rudimentary, cartilaginous; few of them have more than a single point of ossification, and they are connected merely by soft bands which will ultimately become powerful and elastic ligaments. This is not the foot that is described in the text-books, the foot that is ordinarily capable of supporting a body weighing one or two hundred pounds, and under extraordinary circumstances, as in leaping and jumping from heights, sustaining without inconvenience a pressure equal to many hundreds of pounds.

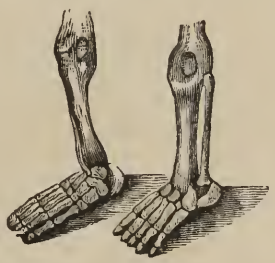

FIG. 2. Feet of the infant.

Guéniot has pointed out the following method of determining whether the inversion of the foot, which exists at birth, is a normal or a pathological condition: Hold the child under the arms, and turn its back to an open fire, it immediately flexes the thigh on the trunk and the legs upon the thighs, and turns the feet outward, the sole towards the heat. This last movement cannot be accomplished if the feet are deformed.

The size of the foot, its length and breadth, is greater in the

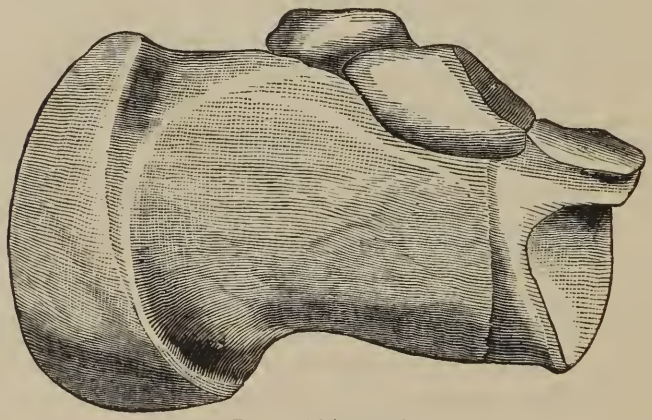

Fig. 3. Adult astragalus.

infant, in proportion to its height, than in the adult, and the whole foot is larger in proportion to the size of the body. The part of the foot anterior to the tibio-tarsal articulation, attains its normal shape and development much earlier than the posterior part. The foot increases in length more rapidly on the inner, than on the outer side, and it is owing to this fact that the sole is gradually turned outwards. These changes are the result of alterations that take place in the different bones of the foot, during growth,

and the progress of ossification; they are much more marked at four, and about the eighth year, all the bones have assumed their normal proportion.

The astragalus may be considered the most important of all the bones of the foot, and it is the first to assume definite form. The os calcis, on the contrary, undergoes a much more marked change; in the infant, the anterior part is long, and the tuberosity unusually small. (Figs. 3 and 4.) The tuberosity extends but little beyond the posterior border of the astragalus, and the groove in which the astragalus moves, has little depth. The apophysis is hardly perceptible, the under surface is almost flat, and the height, particularly on the inner border, is extremely low, as compared with the other dimensions of the bone. This condition is hardly changed at two years.

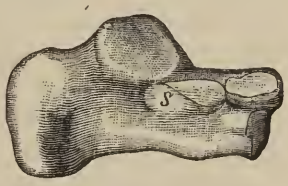

FIG. 4. Astragalus of infant. (After Hueter.)[1]

The movements of the foot are not the same in the infant as in the adult. In the infant, flexion and extension are much more restricted, while adduction and rotation inward, of the sole, is much greater than in the adult. This is due, in a measure, to the laxity of the ligaments, but the difference in the conformation of the articulating surfaces, exercises by far the greatest influence.

[1] The extent of motion possible in the tibio-tarsal articulation and its direction as observed in the adult differ very much from that found in the infant. The dimensions of the bones are also relatively different: compare for instance the os calcis of the adult with that of the infant. On the inner side the suspensory ligament (S) is much lower in the infant. The inner surface of the bone from the top of the posterior articulating surface sinks gradually; in the adult it descends longitudinally with the articulating surface, rises again over the sustentaculum almost to the level of the body of the bone, and then descends anteriorly.

As the individual becomes older, and the articulating surfaces assume a more vertical direction, the movements of adduction and version of the foot inward, are greatly diminished, and at eight years, the movements are precisely those of the adult.

VARIETIES OF CLUB-FOOT.

From the earliest periods, four varieties of club-foot have been recognized. They are designated respectively: *Talipes varus*, when the foot is adducted and the sole turned inward; *Talipes valgus*, when the foot is abducted and the sole turned outward; *Talipes equinus*, when the foot is forcibly extended, the heel being elevated and the sole turned backward; and lastly, *Talipes calcaneus*, comprising those cases in which the foot is strongly flexed, the sole being directed forward. But beside these simple forms, four compound varieties are met with, namely: *Talipes equino-varus; Talipes equino-valgus; Talipes calcaneo-varus*, and *Talipes calcaneo-valgus*. All these forms of club-foot are beautifully illustrated in the casts, most of which were taken from cases occurring in the practice of Dr. Detmold, Emeritus Professor of Clinical and Military Surgery in this institution. Although he was not the first to perform tenotomy in this country, we are certainly indebted to him for the earliest impulse to orthopedic surgery in the United States. His monograph on club-foot, long since out of print, attests his professional ability, and his enthusiasm in this department of surgery.

It is to be observed, that all the varieties of talipes present one common characteristic, viz.: the deviation of the plantar surface from the normal position, and by no amount of force can the whole plantar surface be brought in contact with a horizontal

plane. This condition depends chiefly on a change of relation between the astragalus and the bones with which it is connected.

CONGENITAL AND NON-CONGENITAL TALIPES.

Each of the varieties of club-foot may be either of congenital or of non-congenital origin, the latter being by far the more frequent. From statistics taken from the Maternity Hospital, at Paris, during a period of ten years, from 1858 to 1867 inclusive, it is shown that there were 15,229 births, 8 being born with club-foot: one case of club-foot for every 1,903 births. (*Lannelongue on Congenital Club-Foot,* Paris, 1869.) Mr. Tamplin gives the following statistics, to show the relative frequency of club-foot to other deformities, and the comparative frequency of congenital and non-congenital cases: Of 10,217 cases of deformities of all kinds, treated at the Royal Orthopedic Hospital, London, 1,780 were cases of club-foot; 764 were congenital, and 1,016 were non-congenital. The proportion of congenital, to non-congenital, being as three to two (*Adams on Club-Foot*). The question, whether the deformity is congenital or has been acquired after birth, is of great importance; for although the treatment is similar, the prognosis, both as regards the duration of the treatment, and the ultimate usefulness of the foot, after the removal of the deformity, is much more favorable in the congenital, than in the non-congenital variety. It is necessary, therefore, to distinguish between the two forms, and in young subjects this is easily done. The difference in the external appearances of the two classes of cases, is strongly marked; but in adults there is often great difficulty in deciding the question, for the reason that the characteristic features of the two varieties become effaced, when the child has walked upon the foot for a long time.

I will now mention a few salient points which will aid us in making a differential diagnosis. In congenital club-foot, before the child is old enough to have walked much, the muscles retain their normal size and characteristics; the toes can be flexed, there is some mobility of the ankle-joint, but the foot is quite rigid, owing to the adapted shortening of the ligaments. On the sole of the foot there is, in cases of varus, a transverse depression corresponding with the medio-tarsal joint. There are also marked irregularities on the dorsum of the foot, due to the distortion of some of the tarsal bones, and the temperature and color of the skin is unchanged.

In non-congenital club-foot there is, from the first, a tendency to atrophy and fatty degeneration of the muscles of the leg. The toes are permanently flexed; the great toe is, however, sometimes in a state of forced extension, so severe that it cannot be flexed; the temperature is diminished and the skin is of a bluish color. In cold weather, patients frequently suffer from chilblains; there is an absence of marked rigidity of the foot, which obtains in congenital cases, and instead of the permanent irregularities noticed on the dorsal surface, in congenital cases, the foot, in the non-congenital variety, presents a generally rounded and smooth external surface.

In old cases, when the child has walked on the foot for some time, the distinctive features of congenital and non-congenital club-foot, are less marked. The muscles of the leg, in the congenital form, from want of use, become gradually atrophied, but there is no considerable structural degeneration, as in the non-congenital, and the movements of the foot, in both varieties, are greatly restricted. Owing to the diminished vitality of the parts,

non-congenital cases suffer considerably from irritation of the cushions which bear the pressure, and great inconvenience and pain are experienced in walking, on account of the relaxed condition of the ligaments. Still, the extremely wasted and paralytic condition of the limb, the diminished temperature and bluish color of the skin observed in the non-congenital variety, will materially aid in the diagnosis.

CAUSES.

The *causes* of club-foot have been a subject of considerable controversy, but the scope of these lectures and the strictly practical character which I propose to give them, will not permit an extended notice of the various theories that have been propounded, to explain the etiology of this deformity. The question is one of scientific interest, rather than of practical importance. If I may be permitted to advance an opinion, I should say that both the congenital and the acquired form of talipes, depend upon some irritation of the cerebro-spinal centres causing convulsions in the fœtus, as well as in a newly born child, which result either in muscular contraction or in motor paralysis. There is, however, this marked difference, that in the congenital form there is, in a majority of cases, spasmodic muscular contraction, and in the non-congenital cases there is, nearly always, paralysis of certain muscles or groups of muscles; in the former also fewer muscles are involved than in the latter.

Many orthopedists favor the theory that congenital deformities of the feet, depend upon malposition and pressure of the fœtus in utero, while mothers delight to refer physical imperfections in their offspring, to the influence of material impressions, and mid-

wives narrate such cases, with circumstantial evidence of astounding conclusiveness.

Congenital talipes is often hereditary, and numerous cases might be cited in which mothers have given birth to several club-footed children, and in many cases the hereditary tendency has existed even through several generations. The following illustration, which probably gave rise to a serious domestic trouble, is one of a number, furnished by Lannelongue. (On Congenital Club-foot: Paris, 1869.) "*5th Observation.* — The case related by Bruckner was attended with unpleasant circumstances: Vannier is club-footed, his wife is not; their first three children were club-footed, the fourth was not; Vannier accuses his wife."

It is an interesting fact, yet one which cannot be satisfactorily explained, that the number of cases of club-foot is much greater among males than among females, and that the two feet are liable to be attacked with nearly equal frequency.

In some cases of talipes, certain *complications* are found to exist which also demand attention. The inversion of the toes, in talipes varus, does not always depend upon the malposition of the foot in the transverse tarsal articulation. In the knee-joint we sometimes find a great laxity of all the ligaments, and the knee can be bent in any direction with great facility. In consequence of this, the leg turns inward as well as the foot, in the act of walking, and this continues, even after the foot has been returned to its normal shape. This complication should be noticed and attention called to it at the commencement of the treatment, for it renders the after-treatment tedious and troublesome. Some cases are also complicated by an extreme rigidity of the ligaments of the knee, a rigidity so great that the leg is fixed in one posture, and

can neither be flexed nor extended. These conditions should not escape the surgeon's attention, for they materially modify the prognosis and the duration of the treatment.

In regard to the prognosis, in talipes, you must also remember that the severity of the case depends, not so much upon the degree of the deformity, as on the resistance offered to the restoration of the foot, by manipulation, to its proper form and normal position. In some apparently severe cases, the distortion is easily overcome by manipulation, whilst others, presenting the same grade of deformity, are much more rigid and unyielding.

CHAPTER II.

CONGENITAL TALIPES VARUS. — DEGREES OF THE DEFORMITY. — MORBID ANATOMY. — MECHANICAL AND PHYSIOLOGICAL TREATMENT, AND AGE AT WHICH IT SHOULD BE COMMENCED.

I WILL now consider the different forms of club-foot, beginning with congenital talipes varus, the variety of club-foot most frequently met with at birth, and that which has received the largest share of attention from orthopedic surgeons. Talipes varus consists in the adduction of the foot by the tibialis anticus, the raising of its inner border, the semi-rotation of its inner half by the action of the tibialis posticus, and the elevation of the heel by the muscles of the calf. This is the ordinary type of the deformity, but there are several grades of distortion, which are characterized by the extent of the deviation of the foot from the normal position.

FIG. 5.

In the mildest grade of varus, which is comparatively rare, there is only a slight inversion of the anterior part of the foot, and the heel is not materially elevated. This variety is well illustrated by Figs. 5 and 6. But the grade which is

ordinarily seen is shown in this cast (Fig. 7). The elevation of the heel, you observe, is more decided; the anterior part of the foot is turned inward, so that it forms a right angle with its normal axis, the sole is turned backward and the dorsum directly forward, placing the inner border of the foot upward and the outer border downward. The inner malleolus is almost obliterated; the external, on the contrary, is more prominent than natural, and seems to be placed behind, and below, its usual position. A still more exaggerated degree of distortion is illustrated by this cast (Fig. 8);

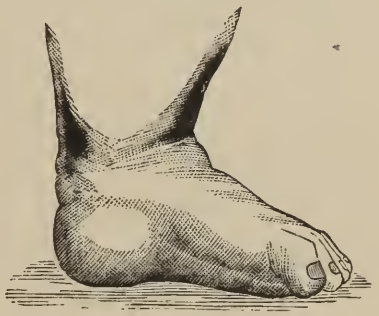

Fig. 6.

Fig. 7.

Fig. 8.

but, fortunately, this degree of deformity is not often met with. The inner edge of the foot is drawn upward, so that the navicular

and the internal cuneiform bones, lie in contact with the inner ankle, and the toes are turned directly upward; the dorsum of the foot is directed forward, the heel is drawn up; there is often rigid contraction of the plantar fascia, which produces shortening of the foot, and a deep transverse depression in the sole.

Where a club-foot has been used for some time in walking, the pressure of the weight of the body produces important consecutive changes. The weight of the body, instead of being transmitted through the arch of the foot, which is so beautifully designed by nature to receive it, is thrown upon the external border, and in severe cases the child walks even on the dorsum of the foot, owing to the doubling into the sole, of the fourth and fifth metatarsal bones. A soft cushion of fat and cellular tissue, is formed on the back of the foot, which enables the weight of the body to be borne with comparative ease and comfort. The ankle-joint and the joint between the bones of the foot, become stiff from disuse, on account of the rigidity of the tendons and ligaments which connect them together. The narrowing of the transverse arch of the foot, produces a well-marked longitudinal furrow in the sole, which terminates at the junction of the middle with the posterior part of the foot ("the transverse tarsal articulation"), in an obliquely transverse depression. These depressions are absent or are but slightly marked, in non-congenital cases. The casts before you illustrate the appearance of the deformity (Figs. 9 and 10).

ANATOMY OF CONGENITAL TALIPES VARUS.

The appearances presented, on the dissection of a case of varus, depend on the degree of the deformity and the age of the

subject. In all cases, however, the structures which enter into the composition of the limb, undergo degeneration for want of proper use. The *bones* become lighter, and the limb is often shortened to the extent of half an inch or an inch. The *ligaments* become adapted to the altered position of the bones. The *muscles* become atrophied little by little, and remain small, even after the limb has been restored to its natural form, and the functions of the muscle restored.

FIG. 9.

In the severe forms of varus, important deviations from the natural form and position, are observed in some of the tarsal bones. This is especially noticeable in the *astragalus*, the *os calcis*, and the *os naviculare*. The astragalus assumes an oblique direction downward and forward; its superior articulating surface becomes almost vertical, so that only the posterior two-thirds are in contact with the articulating surface of the tibia. The anterior third can be felt on the dorsum of the foot, covered only by the elongated capsular ligament of the ankle-joint and the skin. Owing to the displacement of

FIG. 10.

the scaphoid bone inward, the outer portion of the anterior articular head of the astragalus can be felt on the dorsum of the foot; the external articular facet is in close contact with the fibula, the internal is imperfectly developed, and its contact with the inner malleolus is slight and imperfect; the neck is turned inward, and it is this obliquity, chiefly, which gives the characteristic inversion of the foot that distinguishes the deformity. The astragalus has no muscle inserted into it, nor any taking its origin from it. The changes in form and position, which it undergoes, take place as a consequence of the mechanical forces operating on the other two principal bones of the foot, to which it is accurately fitted, and whose movements it must follow. The os calcis, likewise, occupies an oblique, and, in aggravated cases, nearly a vertical position, from the elevation of its tuberosity by contraction of the triceps muscle; the tuberosity is inclined towards the fibula, and, in severe cases, is found in actual contact with it. The anterior extremity is directed obliquely forward and inward. The bone sometimes becomes arched in its long axis, the convexity being directed outward. The *scaphoid bone* is drawn forcibly inward, and upward, so that its tuberosity lies immediately under, and in contact with the inner malleolus, and its long axis is parallel with the long axis of the astragalus, and also of the leg. The position of this bone has the greatest influence in determining the grade of the deformity. The other tarsal bones, viz., the *cuboid* and the *cuneiform*, remain very nearly in their normal positions — they are directed inward, to correspond with the inclinations of the os calcis and navicular bones. In adult cases of club-foot, however, the cuboid bone becomes prominent on the dorsum of the foot, which is turned downward, and supports the weight of the body

in walking. The *muscles* chiefly concerned in producing congenital talipes varus, are those of the calf of the leg and the tibials. These are rigidly contracted, while the peronei and the extensor longus digitorum, are lengthened and kept on the stretch. By far the most powerful of these muscles, and the most important in the production of the deformity, is the triceps suræ, consisting of the gastrocnemius, soleus and plantaris, which, through the tendo Achillis, has a common insertion into the tuberosity of the os calcis. It has been shown by the experiments of Duchenne (de Boulogne [1]), that the action of the gastrocnemius and soleus muscles is, first, to extend with great force, not merely the posterior part of the foot, but also the external half of the anterior part; and, second, the moment the astragalus reaches its extreme point of extension, the muscle causes the os calcis to glide on the articulating facets on the under surface of the astragalus, in an oblique direction from behind, forward, and from within, outward. This slipping of the os calcis on the astragalus, produces a double movement of rotation of the os calcis on its greater axis, and on the axis of the leg, causing adduction of the foot and the turning outward of its dorsal surface. The triceps sura is, therefore, "an extensor adductor," and any one can demonstrate this double function of the muscle, by applying the poles of a Faradic battery over its course. It will be observed that the contraction of the muscle, under the influence of the electric current produces, first, extreme extension of the foot in its tibio-tarsal articulation; it then rotates it, so that its point is directed inward and the heels outward; at the same time it is turned on its antero-posterior axis, its external border is still

[1] De l'Electrization Localisée, par Duchenne (de Boulogne), Paris, 1861.

further lowered, while the inner border is elevated. The result is, the sole of the foot faces inward. It can now be understood that the permanent contraction of the triceps suræ, is sufficient, of itself to produce slight cases of talipes varus. The *tibialis posticus* muscle, which is inserted into the scaphoid bone, and the *tibialis anticus*, which has its insertion into the internal cuneiform and first metatarsal bones, by their contractions, lift the inner border of the foot and rotate it inward, and thus become powerful agents in the production of the deformity. The tibialis posticus is, sometimes, so much contracted that its tendon is forced out of the groove behind the internal malleolus, and is situated on the outer side, or even in front of this process; and, instead of running obliquely downward and forward towards its insertion into the navicular bone, as in the normal foot, it passes directly downward from the inner malleolus, to its insertion into the displaced navicular bone. (*Adams.*) It is important to bear in mind these altered relations of the tendon, when it is to be divided. The tendon of the tibialis anticus muscle, at the point where it is usually divided, as it crosses the ankle-joint, is very much displaced inward. The *ligaments* which bind together the different bones of the foot, and in some cases the plantar fascia, especially its inner portion, contribute materially to keep up the deformity, and to resist the reduction of the foot to its normal position. When the foot has been for a long time in a deformed position, and its motions have been greatly restricted, the ligaments and aponeurosis adapt themselves to the altered position of the bones. The ligaments become shortened on the contracted side, and lengthened on the convex side of the deformity. In some severe cases, the ligamentous adaptation and contraction,

is so firm on the concave side, as to resist the efforts to restore the foot to its normal position, even after all the contracted tendons have been divided. Langenbeck says that it is not the muscles that offer the greatest resistance, but the ligaments, and the contraction of the connective tissue. In some cases — those that originate at an early period of uterine life — there is not merely a mechanical resistance to the reduction of the deformity, but there is also an elastic power in the different tissues, which is more marked in the contracted ligaments than in those which have been over-stretched. This is one of the most frequent causes of relapses in conducting the treatment of this deformity. The mechanical forces to be overcome are, it will be remembered, the contracted muscles of the leg, the contracted ligaments on the concavity of the foot, and in some cases the shortened plantar fascia.

TREATMENT.

In considering the therapeutics of talipes, a question which presents itself at the very threshold is, "At what age shall the treatment be commenced?" I have no hesitation in saying that, if the child is in a fair condition of health, the treatment should be commenced when it is six or eight weeks old. Nothing is gained by delay, but, on the contrary, we know very well that the longer the foot is permitted to remain in an abnormal position, the greater is the resistance to be overcome, owing to the shortening of the ligaments which is constantly going on, thereby fixing the bones more firmly in their abnormal position. It has been objected to very early treatment: *first*, that the child's skin will not bear the pressure of the mechanical force necessary to keep

the foot in position, that ulceration and gangrene are likely to supervene; and *second*, that there is great difficulty in adapting mechanical appliances to an undeveloped and misshapen foot. A considerable experience in the use of plaster-of-Paris splints, in the treatment of club-foot, has convinced me that such objections are unfounded, and club-foot can be treated, in the youngest and most delicate children, without the slightest discomfort. Is there, on the other hand, any age beyond which we cannot hope for a cure? According to Bouvier, it is rare to obtain a satisfactory result, in congenital club-foot, after the age of fifteen or twenty years, even with the aid of tenotomy. He says that talipes and equinus, are curable at a later period than varus and valgus. Malgaigne thinks that we cannot hope for any improvement in congenital varus after the eighteenth year, and this opinion, which is concurred in by most writers, will hold true in the generality of cases.

I do not propose to consider the various plans of treating varus which have been practised, from time to time, by English, French, German, and American surgeons, for, however interesting and instructive such a discussion might be, it would be impossible to engage in it with the limited time I can give to it. The plan which I propose is, to describe merely the treatment adopted by myself, after an experience somewhat extended, in the Brooklyn Orthopedic Infirmary, and the Brooklyn City Hospital, as well as in private practice. This experience comprehends the trial of various plans of treatment which have had the indorsement of high authorities. "The scientific treatment of talipes varus, when severe, as of several other deformities of the limbs," Mr. William Adams very properly remarks, "can only be accomplished by a

judicious combination of the operative, mechanical, and physiological means, while many of the failures still witnessed in the practice of those who have not devoted much attention to the subject, are due to the want of this combination of principles, too frequently considered as antagonistic to one another, but which modern science teaches us are only reliable, in so far as their mutual dependence is recognized and applied by the scientific insight of the surgeon."[1] Mr. Adams has, more strongly than any other writer, inculcated the importance of the *physiological* treatment, in addition to the operative and mechanical, in the management of varus. The *physiological* treatment consists in passive motions of the tibio-tarsal, transverse tarsal, and other joints of the foot, shampooing the muscles with dry, hot flannels — dry heat having a marked influence in restoring nervous energy — and localized electrization (galvanization and Faradization) of the muscles, especially of the weakened peronei muscles. Every experienced orthopedist must recognize the value of the judicious combinations of those methods of treatment, in severe cases. You must not suppose that when you have removed the deformity, by the division of the contracted muscle, and the use of mechanical appliances, that you have effected a cure. You have only palliated the case, and you may have the mortification of witnessing a relapse, or of seeing that the usefulness of the limb has not been materially increased by the treatment: you have not used all the means at your command. In order to effect a cure, you must give tone to the muscles of the limb, promote its nutrition, re-establish its innervation, and loosen up the joints by the use of electricity, local gymnastics, and friction.

[1] On Club-Foot, p. 32, London, 1876.

The physiological after-treatment, is equally, and often more important than the operative or mechanical. The function of the limb must be restored, as well as its form. In a certain number of cases, tenotomy is indispensable in the treatment of club-foot, whilst in other cases, a cure can be effected by the use of mechanical and physiological means alone. Now let us consider the management of cases of club-foot in which *operative treatment is unnecessary*, or in which a reasonable doubt of its necessity, exists. I have already stated that the severity of the case, and the consequent prognosis, does not depend so much on the degree of distortion, as on the resistance offered to the reduction of the deformity, by manipulation. In cases apparently severe, we can sometimes easily overcome the distortion by manipulation, while other cases, presenting even a less degree of deformity, are rigid and unyielding. In deciding, therefore, whether an operation be necessary in any given case, we must be guided by the degree of the rigidity, rather than by the grade of the deformity. If we can, by taking hold of the foot with the hands, bring it quite, or nearly into its normal relations with the leg, it is not, as a rule, necessary to practise tenotomy. The operation should, in such cases, supplement the mechanical treatment, if it should be found necessary. I am aware that many orthopedic surgeons are prejudiced against the use of mechanical appliances without tenotomy, claiming that it subjects the child to great torture, causes it to cry and wail during the whole course of the treatment, not infrequently produces fever and convulsions, and renders a suspension of treatment necessary. I have myself witnessed these dire consequences, from the use of Scarpa's shoe and its various modifications, which exert pressure upon prominent parts of the foot; but,

by the use of plaster of Paris, applied as I shall now describe, which presses not upon the bony prominences merely, but uniformly upon every square inch of surface to which it is applied, a great deal of mechanical force can be used, and for a long time, without the slightest pain to the child.[1] For the reasons, therefore, that the application of plaster of Paris is painless, whatever amount of pressure may be applied, and that the duration of treatment is greatly abbreviated, I cannot too strongly urge this method of treatment, at first, and until the distortion has been overcome, whether tenotomy has been practised or not.

The mode of application, I will now show you. This little patient is the subject of talipes varus, of a mild form, which I expect to be able to cure without tenotomy. I take two pieces of coarse canton-flannel, long enough to extend from the head of the tibia around the heel, to the ball of the great toe, and wide enough to embrace two-thirds or three-fourths of the circumference of the leg. Flannel, with coarse meshes such as I show you, or coarse towelling, should be selected, because they hold a large quantity of the soft plaster. Fine, fresh plaster, such as dentists use, should always be preferred. Unless it is fresh, it does not set quickly, and the hands of the surgeon, while holding the foot in position, will tire before the plaster has hardened, and the foot returns somewhat towards its abnormal position. The plaster is put into a bowl, and warm water is added, stirring constantly, until the mixture is of the consistency of cream. Warm water is used because it hastens the hardening of the plaster. One layer

[1] Plaster was first used in the treatment of club-foot by Dieffenbach. See also papers on Treatment of Deformities of Foot with Plaster, by Professor J. L. Little, *Medical Record*, vol. i., p. 537; and the late Dr. Enos, *Trans. Med. Soc. State N.Y.*, 1863.

of the cloth is now laid upon the table, and its upper surface is covered with a layer of the liquid plaster, spread smoothly with a spatula or a table-knife. The second layer of cloth is then immersed in the liquid plaster and applied evenly and smoothly over the first. The under surface of the first layer, you will observe, is not covered with the plaster, and it is this surface which is to be applied next to the skin. I now, with the aid of an assistant, place it around the limb, from the head of the tibia to the ball of the great toe, carefully folding in the redundant cloth around the transverse tarsal and tibio-tarsal joints, where greater strength of bandage is required, and then cover the whole with a roller-bandage. I now grasp, with one hand, the in-turned foot, in front of the transverse tarsal joint, and force it outward, elevating, at the same time, the external border, while with the other hand, the heel is forced downward. By these manipulations, I abduct and rotate outward, the bones in front of the transverse tarsal joint, and flex the foot at the tibio-tarsal articulation. The foot is firmly held in this position until the plaster hardens, which usually requires about five minutes, if the plaster is fresh. When the rigidity of the tissues is considerable, which is not the case in this patient, the foot may be fixed more firmly in the new position, by the application of some of the liquid plaster over that portion of the bandage which surrounds the back part of the foot, and ankle. The dressing should be removed every four or five days and a new dressing applied, the foot having been first thoroughly washed, rubbed, and manipulated, so as to loosen the transverse tarsal, tibio-tarsal, and calcaneo-astragaloid articulations, and to stimulate the innervation of the muscles. Friction and passive movements, which cause but little pain, materially aid in restoring

the freedom of the joints, and in expediting the reduction of the deformity, and should never be omitted. At each re-application of the dressing, the foot may be brought nearer to its normal position — from five to eight dressings, usually, being sufficient to reduce the deformity, completely. When this has been accomplished, the foot may be put into one of Ahl's adaptable club-foot splints, as shown in Fig. 11. This splint I have found extremely useful, at this stage of the treatment. It is made of felt, stiffened with shellac, and is very pliable, when heated. To adapt this splint, it is immersed in boiling water until it becomes pliable, and is then applied to the foot and leg, which have been previously covered with a thick stocking; the foot is now forced into position with the hands, in the manner already described after the application of the plaster-of-Paris splint, and held until it hardens; it is now covered with a roller-bandage. The splints remain pliable for a few seconds only, and it is well to protect the hands from the heat, with cotton gloves which have been wet with cold water. One advantage of this splint is, that it can be readily removed and re-adjusted by the mother, who should be instructed to shampoo the muscles, and manipulate the foot in the manner already described, in order to restore motion to the joints.

FIG. 11.

It is of the greatest importance that undue pressure shall not be made upon any particular part of the foot, for fear of producing abrasion of the skin or superficial gangrene, which would necessitate a suspension of the treatment. If, therefore, the child, by restlessness or otherwise, shows signs of pain, the splint should be at once removed, and a layer of wool-batting placed over the points of greatest pressure, and the splint re-adjusted.

The electric current, Faradic or constant, will materially assist in restoring the functions of the muscles, which have lost their power, not from absolute paralysis, in the congenital cases, but from disuse. The felt splint may be used until the child is able to walk. It is better, however, as the deformity has been reduced by the above method, to apply Scarpa's shoe, as modified by Tiemann, which is shown in Fig. 12. This not only retains the foot in position, but applies the principle of continued elastic extension, first enunciated by Dr. Henry G. Davis[1] or by Mr. Heather Bigg,[2] and subsequently adopted by Mr. Barwell and Dr. Sayre. This apparatus, with its arrangement of spiral springs, does not in any way interfere with the action of the muscles; indeed, the elastic springs act as substitutes or as assistants to the elongated muscles, which are weakened by disuse, and by aiding in developing this contractile power, often prevent, and sometimes help to overcome fatty degeneration. At the same time the contracted muscles, ligaments, and fascia, while they are kept on the stretch, also have the opportunity of contracting and thus acquiring tone, the function of the muscle being in no way interfered with. Sayre's modification of Scarpa's shoe, is also an excellent instrument. It differs from Tiemann's (Fig. 13), in having a ball and socket joint, instead of a lateral hinge, under the hollow of the foot, and rubber tubing is substituted for the coiled wire

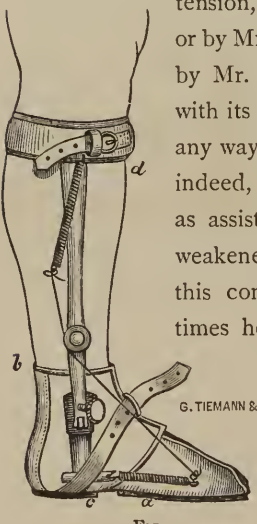

FIG. 12.

[1] *American Med. Monthly*, March, 1857. [2] *Orthopraxy*, p. 289, 2d edition.

springs: the latter, however, are more durable. It is extremely important that the apparatus be accurately fitted to the limb, in all its parts, and that the joints correspond exactly with the axis of rotation of the articulations on which they are to act. When the child is old enough to walk, the shoe should be used during the day and the felt shoe at night. The mother should manipulate the foot, in the manner already described, regularly twice a day, when the shoes are changed.

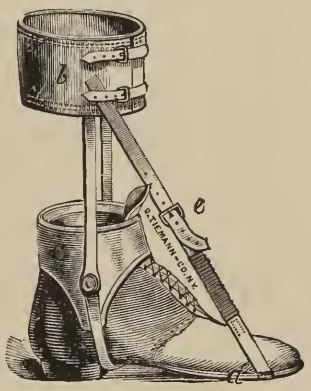

Fig. 13.

When the foot has acquired its natural position, if the child is old enough, it should be encouraged to stand and to walk. The weight of the body becomes a very valuable gymnastic agent, and contributes very materially to the removal of the last traces of the deformity. We should make use of this aid, as early as possible. If the tendons are perceptibly contracted after the mechanical and physiological treatment has been used a month, then tenotomy should be practised, at once. It may still be possible to make a cure by apparatus alone in such cases, but tenotomy will shorten the treatment and expedite the cure. The treatment of the case, after tenotomy, will be considered hereafter.

Such is the plan of treatment which I would advise in cases of club-foot, in which operative treatment is unnecessary, or, in which a reasonable doubt of its necessity exists. The plaster-of-Paris shoe is incomparably superior to any other, in the beginning

of the treatment, and until the deformity is reduced. It is the most comfortable for the patient, it retains the foot in the exact position in which the surgeon's hands put it, and indeed becomes a substitute for the hands and keeps up a constant and long-continued pressure which would be impossible with the hands alone. "The hand," says Bouvier, "is the ideal of mechanical means for reducing the deformity," and this opinion is indorsed by all practical orthopedists.

CHAPTER III.

CONGENITAL TALIPES VARUS, CONTINUED. — OPERATIVE TREATMENT. — NON-CONGENITAL TALIPES VARUS. — PROGNOSIS. — TREATMENT. — EXCISSION OF TARSAL BONES IN OLD CASES OF CONGENITAL VARUS.

Tenotomy. — When the foot cannot be restored, by manipulation, to its normal relation with the leg, or when the os calcis is elevated in a marked degree, so that the foot cannot be flexed nearly to a right angle with the leg, *tenotomy* is absolutely necessary. It is not impossible, even in such a case as this, to accomplish a cure, sometimes, by mechanical appliances alone, but the length of time requisite to obtain a cure will often exhaust the patience and perseverance of both surgeon and patient, and the child is frequently abandoned to its fate. Experience has also satisfied me that relapses are much more common, in severe cases, when they are treated without tenotomy. It is a mere waste of time, to attempt the cure of such cases by the employment of apparatus alone. For the reasons already given, tenotomy should be practised as early as the third month, if the child is in good health.

The treatment of talipes varus by operation, consists in the subcutaneous division of the tendons of the contracted flexor and extensor muscles of the foot, which, by their contraction, resist the restoration of the foot to its normal position, by mechanical

and other means. The most powerful of these muscles — those which exert the greatest influence in opposing the reduction of the deformity — are the triceps suræ, which, as we have shown, not only *extend* the foot at the ankle-joint, but also *adduct* it, and move it in the astragalo-calcanean joint, and, in addition to this, powerfully resist the abduction of the foot, and are sufficient to produce slight cases of club-foot.

The operative treatment, as practised by the English surgeons, Adams, Broadhurst, Little, and Tamplin, consists, in a majority of cases, in the division of the tendo Achillis and the tendons of the tibialis anticus, tibialis posticus, flexor longus digitorum, and, in some cases, the extensor longus hallucis and the plantar fascia. They divide the operative treatment into two stages: First, the varus is converted into equinus, by cutting the tibial and long flexor tendons, and gradually everting the foot by mechanical means; secondly, after the deformity is transformed into a simple equinus, the tendo Achillis is divided, and the extension at the ankle-joint is reduced. During a number of years I faithfully followed the rules established by the English surgeons, and the results were quite satisfactory to myself and to my patients; but, it occasionally happened that I omitted to divide the posterior tibial tendon, in very fleshy children, on account of the danger of dividing the long flexor of the great toe, and of wounding the posterior tibial artery, which lies in close proximity to the tendon, the danger being much increased in fleshy children, and still I obtained the same satisfactory results. This experience induced me to abandon, gradually, the English method of treatment, and for some years past I have limited the operative treatment, in a majority of cases, to the division of the tendo

Achillis, and in exceptional cases, the plantar fascia, for the following reasons: 1. The section of six or eight tendons, which is often done by the English orthopedists, where both feet are deformed, is of itself a matter of no small consequence. Moreover, it has been abundantly shown, though not sufficiently appreciated, that tendons invested by synovial sheaths, including the tibialis posticus, the flexor longus digitorum, &c., never, or hardly ever, re-unite after they have been divided, yet the foot may not be rendered useless by the operation. 2. When the deformity is severe, and the resistance offered to the reduction of the foot considerable, it requires a long time to abduct the foot and rotate it outward, whether the tendons of the tibial muscles have been divided or not, which is evidence that the deformity depends on another cause than the contraction of these muscles. 3. Actual experience has shown that no operative treatment is necessary in ordinary infantile cases, except the section of the Achillis and now and then of the plantar fascia.

The division of the *tendo Achillis*, as performed at the present day, is a perfectly safe and simple operation. The surgeon, having every thing in readiness for the operation, places the patient on his abdomen, with the foot hanging over the edge of the table, an assistant steadies the limb, while the surgeon grasps the foot with one hand, and forcibly flexes it, so as to put the tendon on the stretch. He then, with a tenotome, punctures the skin close to the inner border of the tendon, from half an inch, to an inch and a quarter, according to the age of the patient, above its insertion, and carries it obliquely downward (*Adams*), beneath the tendon, to its opposite side. He then turns the edge of the knife toward the tendon, depresses the handle and divides the

tendon with a clean, transverse cut; the knife is now withdrawn flatwise, so as not to enlarge the external wound. I must caution you against putting the tendon too violently on the stretch, lest the knife be carried entirely through the integument, and thus convert a subcutaneous wound into an open one, with its attendant consequences of suppuration, &c. I have said that the operation is a perfectly simple and safe one, but it should be remembered that the posterior tibial artery is placed at the inner edge of the tendon, superiorly: it becomes detached about the middle of the tendon, and is entirely separated from it, at the inferior portion (Fig. 14). The artery is accompanied in all its course by two large veins, and by the posterior tibial nerve. Now, we are warned by these facts, that, if the tendon is divided too high up, the artery, the veins, or even the nerve may be wounded, and if, on the contrary, the section is made too low down, there will be danger of opening the synovial bursa, which is interposed between the tendon and the upper part of the tuberosity of the os calcis. You can understand now the importance of the direction to divide the tendon, in adults, fifteen lines above the os calcis, while the point of division, in infants, must be varied according to the child's age; but it ought never to be less than five or six lines from the heel. In infantile, congenital, cases the division of the tendon is indicated by a snap, and the divided ends separate so as to leave a gap at the seat of division. In adult cases, and in those of paralytic origin, there is no audible snap, and the divided ends of the tendon are separated to a very slight degree, owing to the rigidity of the ligaments of the joints and the paralyzed condition of the muscles. It sometimes happens that a few of the fibres of the tendon escape

division, in which case the knife should be re-introduced and the section completed.

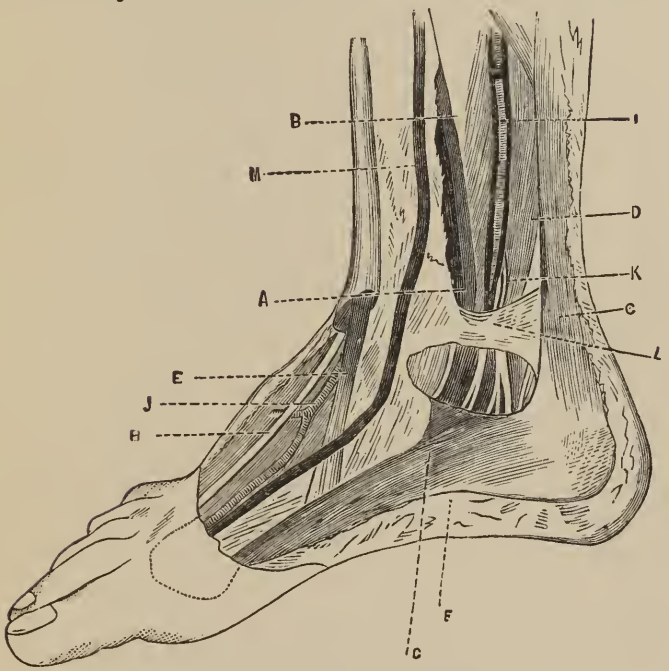

FIG. 14. Relation of tendons divided in varus and equinus. (Erichsen.)

A. Tibialis posticus. Point at which cut.
B. Flexor longus digitorum.
C. Tendo Achillis. Point at which cut.
D. Flexor longus pollicis.
E. Tibialis anticus. Point at which cut.
F. Plantar fascia.
G. Abductor pollicis.
H. Extensor longus pollicis.
I. Posterior tibial artery.
J. Dorsalis pedis artery.
K. Posterior tibial nerve.
L. Part of annular ligament.
M. Saphena vein.

Although I do not advise the division of the tendons of the tibial muscles, in the treatment of talipes varus in the infant, as you may be influenced by the examples of the eminent English sur-

geons whose names I have mentioned, to follow their practice, I will describe the operations, which may in any event be done as a useful anatomical exercise on the cadaver.

The *tendon of the tibialis anticus muscle*, is usually so prominent under the skin as to make its division remarkably easy and free from danger, as it is not enclosed in a synovial sheath, and the arteria dorsalis pedis, besides being deeply seated, is placed on the external side of the extensor proprius pollicis pedis. It should be divided, as it passes over the ankle-joint, by entering the knife close to the tendon, upon its outer side, so as to avoid the artery, carrying it beneath the tendon and dividing it from below, upward towards the skin.

The *tendon of the tibialis posticus muscle*, is, in many cases, divided with difficulty, and the operation is by no means free from danger, on account of its proximity to the posterior tibial artery. Fortunately, its division is rarely necessary. I have adopted the following method: The child is laid upon its back and the leg and foot firmly held by an assistant; the latter is everted, so that the inner side looks directly upward. Now place the thumb of the left hand on the posterior edge of the tibia, as a guide, and puncture the skin with a sharp-pointed tenotome, half an inch above the inner malleolus, and open the sheath of the tendon, freely. The blunt-pointed tenotome, which should always be used in this operation, is then passed into the wound, and keeping its flat surface close to the bone, it is slipped between the bone and the tendon, the edge turned against the tendon which is divided, whilst the assistant forcibly abducts the foot. In the leg of a fat infant, the inner edge of the malleolus and the posterior edge of the tibia, cannot be distinctly defined; and for cases of

this sort, which are by no means infrequent, we should adopt the plan of Dr. Little, viz.: taking the antero-posterior diameter of the leg, make the puncture exactly in the middle of this line. I must beg you to bear in mind that this tendon should never be divided, unless the necessity for the operation is clearly demonstrated, because, in addition to the reasons already given, this and all other tendons that run through tubular sheaths, often fail to unite after they have been divided.

The *plantar fascia* is sometimes so contracted as to offer a serious impediment to the restoration of the foot, and requires to be divided, in order to overcome the shortening of the foot, and to expand its longitudinal arch. The operation is rarely necessary in infantile cases and in childhood, but is more frequently required in adults. It is usually sufficient to sever the inner division of the fascia, but we may also find it necessary to divide the central division. The operation consists in puncturing the skin close to the inner edge of the inner division, and then introducing a tenotome behind the fascia as close to it as possible, and dividing it towards the skin.

At what time is it desirable to begin to straighten the foot? Stromeyer has shown that re-union of the tendons may be complete at the end of the fifth day, and that the tendinous exudation solidifies so rapidly that, in ten days, it may be impossible to reduce the deformity. The plan which I have adopted is to remove the plaster splint which was applied immediately after tenotomy, on the fourth day, wash the foot well, apply another plaster splint, force the foot towards its normal position, in the manner already described, and hold it until the plaster sets. This splint should be re-applied every third or fourth day, and each

time, when it is removed, the foot should be washed and rubbed and the articulations loosened as much as possible, by passive movements, in order to restore the freedom of the joints. The foot should be brought gradually to its normal position, and even into the position of varus, by increasing the extension, somewhat, each time the plaster dressing is applied. The deformity can usually be reduced in the course of two or three weeks, without undue pressure upon any part of the foot, and without the slightest pain. It should now be put into the club-foot shoe (Fig. 12), which will hold the foot in the normal position, without pain and inconvenience. The shoe must be removed night and morning, and the ankle and transverse tarsal joints, manipulated for fifteen minutes by the mother, and the muscles, especially the peronei, should be well shampooed. This shoe should be replaced at night by the felt shoe. The object of gradual extension is to regulate the length of the new material which is formed, and to unite the divided extremities of the tendon. When the extension is excessive, the new material may be elongated so as to make the re-union imperfect, or even prevent it from taking place altogether, and a previously healthy muscle may have its strength materially impaired, or it may even be rendered useless. Standing and walking on the foot will contribute essentially to remove the last traces of the deformity.

How long shall this treatment be continued? We answer, until the deformity is overcome, and the natural movements of the joints are entirely restored. The time required to accomplish this will depend on the age of the patient, and the kind and degree of rigidity which the case presents. After the division of the tendo Achillis, the chief resistance to reduction is offered by

the ligaments; occasionally, however, the tibial muscles refuse to yield to mechanical treatment, and the division of one or both becomes necessary. In severe cases, in which the deformity has been considerable, and the resistance to reduction obstinate, it may be necessary to continue the treatment for eight or twelve months. For a longer period than this, even, the foot may exhibit a tendency to return to its abnormal position, and, so long as this tendency exists, the treatment should be continued. Relapses frequently occur from a neglect of this important rule. When the deformity has been entirely removed, and free motion obtained in the joints, the child should wear, during the daytime, the boot which is represented in Fig. 15. It differs from an ordinary leather shoe in being open farther down in front, so that the foot can be introduced with greater ease; to this is added a steel plate, fastened to the outer side of the heel, with a movable joint to correspond with the ankle, and connected above with a strap encircling the calf of the leg. This boot maintains the joints in their normal position during growth, and assists the muscles in acquiring symmetrical action.

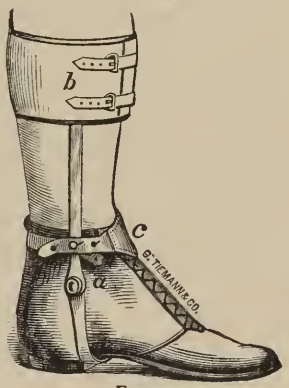

FIG. 15.

The physiological treatment, consisting of frictions with dry, hot flannels, passive motion, electricity, &c., as I have previously described, should be rigorously pursued. It has an important influence in overcoming the deformity and in restoring the functions of the muscles and joints. The re-establishment of the

functions of the foot is scarcely less important than the removal of the deformity. If the treatment is limited merely to overcoming the distortion of the foot by operative and mechanical means, very little benefit will have been conferred upon the patient. The gait will be awkward and inelastic, from the want of normal movements in the articulations, and there will be great danger of a recurrence of the deformity.

Congenital varus is frequently accompanied with a bad condition of the ligaments of the knee-joint, which allows the leg and foot to turn inward, in the act of walking, even after the deformity has been cured, and free motion at the ankle-joint has been restored. In order to control this tendency to inversion of the foot, a retentive apparatus must be used which extends above the hip-joint, and is connected with a pelvic belt. Such an appliance is shown in Fig. 16. The pelvic belt is made oval, so as to prevent its turning upon the body, and the perpendicular stem is thus kept in a line with the body, while the foot may be set to any degree of obliquity, by the position of the shoe in the plate to which it is attached. The instrument should be worn as long as any tendency to inversion exists.

Fig. 16.

The treatment of talipes varus, which I have recommended differs, in some important respects, from that pursued by the English orthopedists; and I should not have presumed to differ with such high authorities, if I had not subjected the various plans of treatment to the test of actual experience, in a considerable

number of cases, both in public and in private practice. I will briefly recapitulate the mode of treatment which I employ.

1. A large number of cases of varus can be cured, by mechanical means alone, if the foot can be brought, by manipulation, completely or nearly into its normal relations with the leg. Plaster-of-Paris splints, either without or with tenotomy, should be used, until the deformity is reduced, and then a club-foot shoe should be substituted for it, employed in the manner which I have advised. You need have no apprehensions of having a stiff and unwieldy foot after the cure of the deformity, a result much dreaded by orthopedists who have not used the gypsum splint or have not employed it in the manner I have recommended.

2. In a large majority of cases, I limit tenotomy to the tendo Achillis. It is only in exceptional cases of varus, that section of any other tendon is required.

3. The physiological treatment should be practised from the beginning, and continued until the distortion has been overcome, the motions of the joints restored, and the functions of the muscles re-established. Remember that you have not cured the patient by reducing the deformity; the limb will be of little use unless the functions, as well as its form are restored.

Non-congenital talipes varus generally arises from infantile paralysis, caused by the irritation of teething, or from a disturbance of the cerebro-spinal system of nerves, arising from some of the disorders of childhood; it is also, sometimes, caused by inflammation or injury of the joint. These cases are not usually seen until after the period of childhood, for although the cause which leads to the deformity, generally begins in infancy, the distortion is developed very gradually, and the surgeon is not con-

sulted until the inconvenience in walking has become very decided. When all the muscles of the leg are paralyzed, the tendency of the weight of the body is to twist the foot inward, during progression, and this tendency is more marked and rapid, when the paralysis is limited to the abductor muscles, the peronei, extensor longus and sometimes the extensor pollicis. The adductors, having no active opposing force, invert the foot during locomotion. It is important to *diagnosticate* the non-congenital from the congenital form of varus, because the prognosis is much more favorable, as regards the usefulness of the limb, in the latter than in the former variety. In young subjects there is no difficulty in making a diagnosis, but when non-congenital cases are seen in the adult there is often great difficulty in deciding the question, because the characteristic features of the two forms become effaced when the foot has been used in walking for a long time. But the wasted and paralytic condition of the limb, the rounded and smooth external surface of the foot, observed in the non-congenital variety, is in such marked contrast with the definite irregularities and rigidity of the foot in the congenital variety, as to materially assist in the diagnosis, even in adult cases.

The prognosis, in non-congenital talipes, is favorable, so far as it relates to the simple removal of the deformity, but as regards the power and usefulness of the limb, it is much less favorable than in the congenital form, except in those cases not caused by paralysis.

The treatment of non-congenital talipes, is conducted on the same general principles that guide us in the management of the congenital form of the distortion. Tenotomy, however, is only necessary in exceptional cases. The mechanical and physiologi-

cal treatment, is generally sufficient to restore the foot to its normal position, and this is ordinarily accomplished in about one-third the time that is required for the congenital cases, owing to the weakened condition of the muscles and the want of rigidity in the ligamentous structures. It is necessary to conduct the mechanical treatment more cautiously than in the congenital deformity, in order to avoid sloughs from pressure, which are more likely to take place, owing to the paralytic condition, and the consequent diminished vitality of the limb. The same appliances may be used that we have advised for congenital talipes, viz., the plaster-of-Paris splint, or the felt splint, until the deformity is reduced; and then, an appropriate club-foot shoe, which you must be sure fits the foot accurately and comfortably, may be worn (Fig. 12). The physiological treatment is even more important in this form of the disease than in the congenital, and should be thoroughly and persistently applied. When the deformity cannot be reduced by mechanical and physiological treatment, we must, in addition, divide the resisting structures, in the manner already described.

After the deformity has been cured, it will be necessary, in consequence of the paralytic condition of the limb, for the patient to wear a retentive apparatus for many years. The apparatus which I have shown you before, will answer for most cases. (See Fig. 15.) If, however, the paralysis extends to the muscles above the knee, the support should be carried up to the hip-joint, and connected with a steel belt around the waist. (See Fig. 16.) The foot should also be supported, at night, by a felt splint or some simple form of shoe (Fig. 15), in order to prevent a re-contraction of the ligaments and muscles, and a consequent return of the deformity.

Before leaving this subject, I must not neglect to call attention to the operation of excision of one or more of the tarsal bones, which is sometimes practised in old and bad cases of congenital varus, in the adult.

The late Mr. Solly, of St. Thomas' Hospital, removed the cuboid in one case, and the operation has been repeated four times, successfully, by Mr. Davy, of the Westminster Hospital. The latter surgeon has also, in three cases, removed a wedge-shaped block of the tarsal arch, embracing the cuboid, the head of the astragalus, part of the scaphoid, the base of the little metatarsal and a chip of the external cuneiform bone (*British Medical Journal*, Dec. 15, 1877); and Mr. Davis-Colley, of Guy's Hospital, has performed a similar operation. The astragalus has been removed by Mr. Lund, of Manchester, and by Professor Erskine Mason, of New York, for the same deformity, the latter gentleman not having been aware that the operation had been previously practised.

I have had no personal experience with these operations, but in confirmed and very aggravated cases the patient is, I think, entitled to the benefits they may confer.

CHAPTER IV.

TALIPES VALGUS, OR FLAT-FOOT. — MORBID ANATOMY. — CONGENITAL AND NON-CONGENITAL. — TREATMENT. — TALIPES EQUINUS. — MORBID ANATOMY. — TREATMENT. — EQUINO-VARUS AND EQUINO-VALGUS. — TREATMENT.

I WILL now consider another deformity of the foot, known as talipes valgus. This distortion is the direct opposite of varus, and is much less common, especially as a congenital affection. We shall study first the congenital form.

An attempt has been made to distinguish between flat-foot and talipes valgus, but the distinction is purely arbitrary, and they should be regarded merely as degrees of the same distortion. The term "flat-foot" is applied to that condition in which there is simple sinking of the arch of the foot; and "valgus" to that state, in which, in addition to the obliteration of the arches, there is eversion and elevation of the outer border of the foot, and the weight of the body rests on its inner margin. The cast represents this deformity a little more marked than we usually see it. (Fig. 17.) A more severe distortion is shown by this cast. (Fig. 18.)

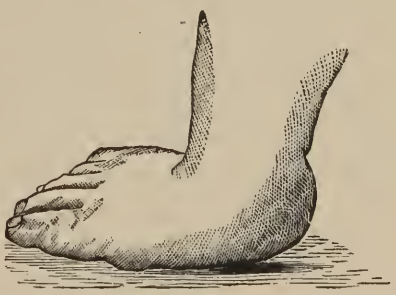

FIG. 17.

The arches of the foot, which you will remember are scarcely perceptible in early infancy, are held in position chiefly by the calcaneo-scaphoid ligament, and the ligaments connecting the scaphoid with the cuboid and the cuneiform bones. A weakness or congenital elongation of these ligaments, permits the arches to sink. The foot, consequently, presents a flattened appearance, and its various movements are seriously interfered with. Sometimes the longitudinal arch is reversed, so that the plantar surface of the foot is convex instead of being concave. This flattening of the arches, together with a greater or less degree of eversion of the anterior part of the foot, which takes place at the transverse tarsal joint, constitutes the essential features of valgus.

Fig. 18.

When, in addition to the deviation just described, we have elevation or depression of the os calcis, the compound varieties of talipes, *equino-valgus* and *calcaneo-valgus* are produced. But these do not merit special consideration; they may be considerd as cases of talipes valgus, with or without contraction of the gastrocnemius muscle. When the patient begins to walk, all the external characteristics of congenital valgus become more marked, and the pain and inconvenience which he suffers in walking, are much greater from this deformity than from congenital varus.

Morbid Anatomy. — Dissection shows that the deviation of the foot, in valgus, is due to the rotation of the bones of the posterior part of the foot, particularly the scaphoid and the os calcis, on

the cuboid; the deviation of the bones, however, is not so great as in varus; the os calcis is rotated to such a degree that its inner, concave, surface is turned downward, and its long axis has become oblique from behind, forward, and from without, inward, and its tuberosity is elevated to a variable extent.

The *astragalus* may occupy its normal position, or it may be tilted forward and obliquely downward, at birth, by the elevation of the tuberosity of the os calcis. The *scaphoid* and *cuboid* undergo a certain amount of rotation, and are completely luxated upon the astragalus and os calcis. On the inner side of the foot, three bony prominences are noticed: the internal malleolus, the head of the astragalus, and the tubercle of the scaphoid, which is much depressed.

The *ligaments* on the inner side of the foot are elongated, while those on the dorsum and external side are shortened; exactly the reverse of what is observed in congenital varus. It is unnecessary to go into details.

The *muscles* in this deformity, as in cases of congenital varus, are merely shortened, without alteration of structure; and, after the cure of the deformity, the muscular power of the limb is unimpaired. The deviation in the direction of the tendons is less marked in valgus than in varus, and they are less easily recognized. In ordinary cases the contracted muscles are the peronei and the long extensors of the toes, and, in severe cases, the triceps suræ. The peroneus tertius and the long extensors of the toes, in their action, raise the outer edge of the foot; the peroneus brevis, and the longus, abduct the anterior part.

The *prognosis*, in congenital valgus, is usually favorable. When the treatment is begun at an early age, the distortion is easily over-

come, and the usefulness of the limb can, as a rule, be perfectly established. When, however, the limb has been walked upon for some time, or when the deformity is associated with some malformation of the leg, there is greater difficulty in effecting a perfect cure.

NON-CONGENITAL TALIPES VALGUS.

The external character, and the changes in the relative positions of the bones which are observed in congenital valgus, are so similar to that of the non-congenital form of the affection, that the description of the former may properly be applied to the latter. The longitudinal and transverse arches of the foot are obliterated, so that the inner margin of the sole rests flat upon the ground, in standing. At first, the arches are partially restored when the superincumbent weight is removed; but, after a time, the gradual yielding of the tarsal ligaments in the sole of the foot, causes the foot to remain flat. In persons who stand much, these ligaments sometimes become so much elongated that the plantar surface becomes convex, reversing the normal arches of the foot, as in the congenital form. The *outer margin* of the foot is not raised, as in the congenital variety, because there is no active muscular contraction; in fact, there is a feeble and over-stretched condition of the muscles, which gives rise to more or less eversion of the foot. Obliteration of the arches of the foot, producing flat-foot, is therefore the essential characteristic of non-congenital valgus. In cases of very long standing, however, the foot, from long-continued use, becomes bent upon itself, at the transverse tarsal joint, and is held in this position by the muscles, which become permanently shortened.

This form of valgus may be caused by infantile paralysis, affecting one or both tibial muscles; sometimes, it follows convulsions which have been excited by dental irritation, or by febrile disorders; it may result from injuries or from disease of the ankle-joint or foot; or from debility of the ligaments and muscles, accompanied with general debility. It often arises from the patient's habit of carrying heavy weights, or from his being for many hours in succession on his feet, especially if he has not a vigorous physique.

TREATMENT OF CONGENITAL VALGUS.

The pain and lameness produced by talipes valgus, are greater than exist in any other deformity of a similar degree, and, hence, this branch of the subject should receive most careful attention. The rules laid down for the treatment of congenital varus, apply equally to the deformity now under consideration. A judicious combination of the physiological, mechanical, and operative means, varying with the amount of deformity and the rigidity of the foot, is as important in one distortion as in the other. If the foot can be completely adducted, or brought nearly into its normal relations with the leg, by the hand, tenotomy is not usually required. In such cases we can effect a cure by the application of gypsum or felt splints, in the manner already shown for the treatment of varus. The foot, however, must be forced into a position directly the reverse of that practised in varus — by grasping it with the hand, in front of the medio-tarsal joint, and forcing it inward, elevating at the same time its inner border; while, with the other hand, the heel, if it is elevated, is forced downward. The foot is held in this position until the plaster "sets." The same rules

given for the removal and re-application of the plaster, and for the physiological treatment of varus, are applicable to this deformity. When the distortion has been overcome by the treatment here described, an apparatus essentially similar to that used in varus, but acting in an opposite direction, should be applied (Figs. 12 and 13). A convex pad should also be placed inside the shoe, in the normal situation of the arch of the foot. This presses inward and upward, and elevates and supports the arch of the foot. As soon as the child is able to walk, it should be encouraged to do so, for the weight of the body on the foot assists materially in the removal of the last traces of the deformity.

If the tendons continue rigid, and the distortion is not overcome by the diligent use of plaster-of-Paris splints for three or four weeks, it is then necessary to resort to tenotomy. The peronei tendons only require division, in the slighter cases. In more severe cases, it may be necessary also to divide the extensor longus digitorum and peroneus tertius. When the gastrocnemius is tense and unyielding, producing equino-varus, the tendo Achillis should be divided. The rule is to divide the tendons when retraction cannot be overcome. The muscles offer a real and invincible resistance to the means employed for that purpose. The peroneus longus and brevis tendons may be divided, one inch above the external malleolus, in the following manner: The leg, lying upon the inner side, is firmly held by an assistant, with one hand, while the foot is forcibly adducted, by the other. You then, with the forefinger of the left hand, feel for the tendons, which you will generally find raised above the level of the fibula; introduce the tenotome flatwise, between the bone and the tendons, turn the sharp edge of the knife to the tendons, and divide them trans-

versely. The extensor longus and peroneus tertius should be divided, when necessary, just where they pass over the ankle-joint, in the following manner : —

The foot is adducted, by an assistant, a puncture is made close to the inner side of the extensor longus, a tenotome is passed beneath the tendons, and they are divided from below upward towards the skin. The tendons are prominent and tense, so that you will have no difficulty in ascertaining that they are completely divided. If it is also necessary to divide the tendons of the anterior tibial and extensor pollicis — and this is sometimes the case in old subjects — the knife can be re-entered at the same puncture, and carried in the opposite direction, beneath the tendons, flatwise, and cutting towards the skin. You can then apply a pledget of lint over the puncture, and secure it in position by a strip of adhesive plaster and a bandage, around the foot and ankle. The part should at once be put into a plaster-of-Paris or a felt splint, which has been carefully moulded to the deformed foot before the operation, and kept in this position for three or four days, when all the dressings are removed, the parts well washed, a plaster splint applied in the manner already shown, and the foot forced toward its normal position ; this splint should be removed every third or fourth day, at each application bringing the foot nearer to its natural position. When the deformity has been reduced, the foot can be retained in an appropriate club-foot shoe, without pain or inconvenience. In some severe cases, it may be necessary to use an apparatus which extends up the thigh, with a free hinge-joint at the knee. It is merely an elongation of the ordinary apparatus, but is more powerful in its action.

The club-foot shoe should be worn during the day, for six or

twelve months, in order to allow the bones, muscles, and ligaments to adapt themselves to the changed position of the foot. After the removal of the deformity, and to guard against relapse, a retentive apparatus should also be worn at night. This may consist of a lighter metal shoe or of a felt splint.

The physiological treatment is as important here as in varus, and should be practised during the whole course of the treatment, until the functions, as well as the form of the foot, are fully restored.

The tendency to relapse is not so great in valgus as in varus, because it is a less complicated deformity, and it may be prevented by the use of an ordinary valgus shoe, after the club-foot apparatus has been laid aside. The heel should be raised on the inner side, so as to throw the weight on the outer side of the foot, and an elliptical steel plate inserted into the sole of the shoe, for the purpose of sustaining the arch of the foot; this support must be gradually discontinued. (Fig. 19.)

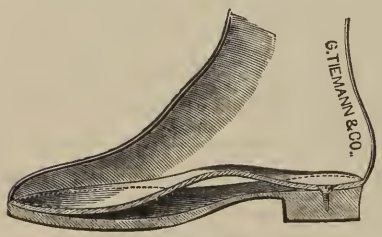

FIG. 19.

TREATMENT OF NON-CONGENITAL VALGUS.

The treatment of non-congenital valgus is essentially similar, in principles and in detail, to the treatment appropriate to the congenital form. Operative treatment, however, is rarely necessary, the mechanical and physiological means alone being sufficient, in a large majority of cases, to effect a cure.

The next frequent cause of non-congenital valgus is, general and local debility, producing what is commonly called "flat-foot;" and in these cases, the general health should receive careful attention. Fresh air, good food, iron, quinia, &c., should be judiciously used; while, in many cases, the only local treatment required is a properly-constructed valgus shoe, such as I have before described (Fig. 19).

In more severe cases, it may be necessary to carry a steel support from the shoe up the leg, on the outer side, to be connected with a plate which surrounds the calf, having a joint at the ankle. This apparatus is sometimes required for many years.

When there is marked eversion of the foot and deviation of the heel, we endeavor to reduce the deformity with the plaster-of-Paris splint in the manner already described, and, when the distortion is overcome, the club-foot shoe already recommended, should be applied. When, as in severe and long-standing cases, the deformity cannot be overcome by mechanical means, it may be necessary to divide the tendo Achillis, or the extensor and peronei tendons; but tenotomy will seldom be required in non-congenital cases.

Special exercises, frictions, galvanism, &c., are extremely important in this form of club-foot, especially when it has a paralytic origin; indeed, the physiological treatment, properly and thoroughly carried out, not only contributes to the cure, but also materially aids in preventing a relapse of the deformity.

TALIPES EQUINUS.

I will now call attention to the simplest and most frequent form of club-foot, *talipes equinus*, or *horse-foot*, so called from its supposed resemblance to the foot of the horse.

In the opinion of all authors, simple equinus is rarely congenital, but we find, at birth, combinations of this distortion with other varieties, such as equinus varus and equinus valgus. "I have met," says Mr. Tamplin, "with pure talipes equinus congenitus." It usually occurs in infants, under five years of age, but it may commence much later in life.

In well-marked cases of talipes equinus, there is complete elevation of the heel, unaccompanied with lateral distortion, either inward or outward, increase in the concavity of the longitudinal arch, producing shortening of the foot, and a corresponding prominence of the head of the astragalus on the dorsum. The patient, in walking, rests entirely on the heads of the metatarsal bones, which become separated from one another in consequence of the pressure of the weight of the body, so that the anterior part of the foot is increased in width.

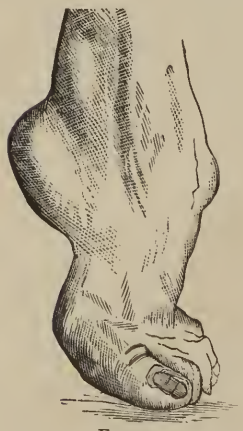

Fig. 20.

These appearances are well shown in the cut (Fig. 20), which represents a typical case of talipes equinus, in the adult. There are, however, various degrees of the deformity, depending on the amount of flexion in the tibio-tarsal articulation. We may have simply *rectangular contraction of the tendo Achillis*, a condition in which the heel touches the ground, and the movements of the ankle-joint are free, except when the patient attempts to raise the foot beyond the right angle, when the leg is extended, giving rise to great inconvenience in walking; or the deformity may involve the utmost possible elevation of the os calcis.

The toes are usually in a condition of forced extension — drawn up at right angles to the metatarsal bones, as is seen in the cut (Fig. 21). This indicates that the anterior muscles of the foot and leg retain their power; and when they are affected with spasm, the toes are flexed upon themselves, as seen in the cut (Fig. 22).

FIG. 21.

FIG. 22.

In exceptional cases, all the anterior muscles are completely paralyzed, and the ligaments are greatly relaxed. The foot then becomes bent upon itself, so that the dorsal surface rests upon the ground. This condition is well represented by the cut (Fig. 23).

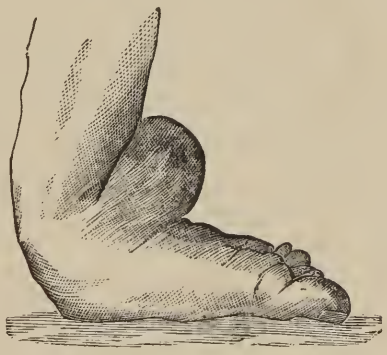

FIG. 23.

When we study the *pathological anatomy* of this deformity, we find that the *bones* have undergone very little change in form. This is true even in cases which, beginning in childhood, have existed for many years. The *position* of the bones, however, is materially altered. The tuberosity of the os calcis is raised, by the contraction of the

gastrocnemius and soleus muscles, sometimes, to such a degree that the upper surface of this bone is brought in contact with the posterior surface of the tibia. The degree of elevation of the heel depends, not merely on the amount of contraction of the muscles of the calf, but also on the amount of flexion of the anterior or the posterior part of the foot, at the transverse tarsal joint.

The degree of elevation of the heel is often more apparent than real. The elevated position of the os calcis causes the *astragalus* to project downward and forward, and its head presents prominently, on the dorsum of the foot (Fig. 20).

The metatarsal bones approximate to a vertical position, and, in old and severe cases, their anterior extremities are separated laterally, thus increasing the breadth of that part of the foot. In the cases already mentioned, when the paralysis is complete and the foot is retroverted, the metatarsal bones are situated at right angles to the leg, as seen in Fig. 23.

The ligaments are either elongated or contracted, according to their situations on the anterior or the posterior surfaces of the foot, and in proportion to the degree and duration of the deformity. The muscles chiefly concerned in the production of talipes equinus, are the triceps suræ, which elevate the os calcis, and the flexor brevis digitorum, which contracts the longitudinal arch of the foot. The plantar fascia is also contracted. The structure of the muscles will be found in varying stages of fatty and fibrous degenerations, the changes depending upon the cause and duration of the deformity. In cases of paralytic origin, especially, fatty and fibrous degeneration usurp the place of normal muscular fibre, while, in cases of spasmodic origin and those arising from

injuries, the healthy muscular tissue has degenerated very much less.

Causes. — By far the most frequent causes of non-congenital talipes equinus are, muscular spasm of the triceps suræ, and paralysis of the anterior muscles of the foot and leg. It also arises from wounds of the gastrocnemius, or of the nerves supplying that muscle, and abscesses occurring in the course of the muscle, and about the ankle-joint, long-continued, unchanged position, and from scrofulous and rheumatic inflammations of the ankle-joint.

Prognosis. — With regard to the *prognosis* of talipes equinus, we must consider, in the first place, the nature of the cause — whether the ankle-joint is directly or indirectly affected.

In the former class of cases, the deformity depends, usually, upon paralysis of the flexors of the foot, and contraction of the triceps suræ, and the prognosis is based upon the degree of paralysis, and the condition of the muscular structure.

When it is produced by a puncture or other wound of the muscles of the calf, or their nerve-trunks, or by abscesses in the course of the muscle or in the neighborhood of the ankle-joint, the prognosis is generally favorable, both as regards the removal of the deformity, and the restoration of the functions of the foot.

When the distortion arises from *causes directly affecting the joint*, such as rheumatic or scrofulous inflammation, in which there is a strong disposition to bony anchylosis, the prognosis is less favorable.

The age of the patient, as well as the duration and degree of the deformity, have an important influence on the length of the treatment, and also on the ultimate result, and should cause us to be guarded in our prognosis.

In a large majority of cases, the deformity can be removed by appropriate treatment, and the foot can be kept in proper position, by suitable appliances; but, to re-establish free motion, and complete voluntary power over the foot, and to give tone to the muscles, is not so easily accomplished, especially when the distortion is due, either to complete paralysis of the flexor muscles, or to causes directly affecting the interior of the joint. In cases of long standing, the bones themselves participate in the deformity, and of course this malformation exercises a material influence on the prognosis.

TREATMENT.

The treatment of talipes equinus involves the use of mechanical, physiological, and operative means, depending upon the cause and degree of the deformity.

For cases *caused by paralysis of the flexor muscles*, the physiological and mechanical treatment, is usually sufficient. We should endeavor to overcome the paralysis, according to the rules previously suggested for the physiological treatment, viz., by passive exercises, frictions, dry heat, massage, electricity, &c.

We should at the same time endeavor to counterbalance the action of the extensors, by the use of the apparatus here represented (Fig. 24). It consists of two lateral, upright bars, fastened to the iron sole of a strong shoe, jointed at the ankle, and connected to a band below the knee. A stout, elastic strap, extends from a stirrup over the toes, to the calf-band, and supplies the place of the paralyzed flexors. This strap may be regulated to any degree of tension. The heel is retained in its place by a strap across the instep.

In mild cases — those in which the foot can be flexed with the hand — the apparatus, conjoined with the physiological treatment, will be sufficient to accomplish a cure. If these means fail, shall we, in paralytic cases, resort to tenotomy? This will depend upon the degree of paralysis of the flexors, and the degree of contraction of the extensors. If there is complete paralysis of all the anterior muscles of the leg, with but slight contraction of the posterior muscles, I have no hesitation in saying that no benefit will result from the operation. The paralysis is, however, usually limited to a few muscles, while others retain a considerable amount of power. The muscles involved, and the degree of paralysis, can be quite accurately determined by galvanization, or by faradization.

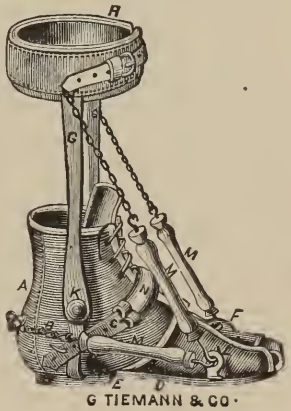

FIG. 24.

When the paralysis is not complete, I should recommend section of the tendo Achillis, for it is a matter of experience, that the removal of the contraction materially aids in the restoration of power to the paralyzed muscles.

The tendo Achillis must be divided, in the manner previously described (page 79), and the subsequent treatment consists in keeping the foot at rest, in its abnormal position for three or four days, by the use of a plaster splint, and afterwards applying the apparatus just described (Fig. 24).

The tension of the elastic strap should be so regulated as to bring the foot very gradually to its normal position, not making

the extension too rapidly, lest the connecting medium be too much elongated, and thus destroy the function of the gastrocnemius, or produce the opposite condition, calcaneus; nor so slowly that the tendon will be re-united before the distortion has been entirely removed. The extension should be completed in about six weeks.

What shall we do for *cases of rectangular contraction of the tendo Achillis?* In these cases, you will remember that the heel touches the ground, in standing, and there is sufficient contraction of the tendo Achillis to prevent flexion of the foot, beyond a right angle with the leg, but there is no obvious deformity. This slight contraction, however, gives rise to serious inconvenience and lameness, as you can readily understand, when you remember that we raise the foot beyond the right angle, in every act of walking or running.

This class of cases may arise from any of the causes of talipes equinus already enumerated, and we may say, generally, that the same rules of treatment apply to them, as to other cases, with the exception that, in no case should tenotomy be performed, unless the muscles are in a healthy condition. In other conditions, the operation may often be performed with great benefit to the patient.

In cases of talipes equinus, the *result of active contractions or spasm of the extensor muscles*, or arising from causes affecting the joint, the treatment should be initiated by tenotomy.

Passive exercises, electricity, &c., even when combined with mechanical treatment, will not overcome the distortion, except in very recent and slight cases; but they are useful adjuvants to the operative treatment. If any of the joints that are essential to the

proper movements of the foot are anchylosed, it will be useless to attempt a cure even by a section of the different tendons.

The tendo Achillis is, usually, the only tendon requiring division; but, occasionally, you will find the posterior tibial, and the peronei, so tense that the foot cannot be flexed, even by considerable force, after the tendo Achillis has been divided, thus making their division also necessary.

You are not often required to divide either the plantar fascia or the flexors of the toes, although they may appear quite tense and contracted before any tendons are divided. You will find that the contraction of the longitudinal arch of the foot disappears, and that the toes assume their natural position, at least as a general rule, when the foot has been brought to a rectangular position with the leg. Should they not do so, the division either of the flexor tendons or the plantar fascia, or both, in severe cases of long standing, may become necessary.

TREATMENT AFTER OPERATION.

After the cutaneous punctures have healed, Scarpa's shoe must be applied, and gradual mechanical extension made, until the foot is restored to its normal position. The extension, should be so conducted as to regulate properly the length of the new material, uniting the divided extremities of the tendon.

The physiological treatment must be employed, as soon as the position of the foot has been restored by mechanical means, for the purpose of establishing the functions of the joints and muscles; for you would commit a very grave error, if you limited your treatment merely to the removal of the malposition of the foot. "To restore the foot to its normal position," says Malgaigne, "is not to

cure it, any more than we cure a fracture when we try to reduce it." Unless the power to use the limb has been restored, but little benefit has been conferred upon the patient. Electricity, shampooing, dry heat, and flexion and extension of the foot, for a quarter of an hour, two or three times a day, are the means to be used, in these and similar cases, until the parts are brought into as healthy a condition as can be obtained.

It is often necessary, after the distortion has been removed, and the functions of the joints restored, to support the ankles by two side steel supports, attached to the boot, having joints corresponding to the ankle-joints and connected at the calf by a metal plate, to which a strap is attached, fastening in front. A stop-joint at the ankle may be used, if necessary. With this apparatus, and proper attention to exercise, there need be no apprehension of re-contraction taking place.

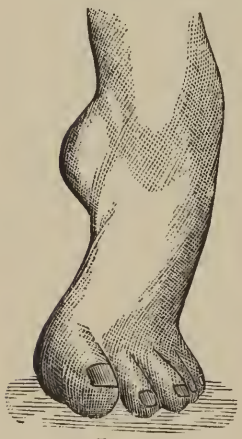

FIG. 25.

FIG. 26.

EQUINO-VARUS AND EQUINO-VALGUS.

Equino-varus and equino-valgus are compound varieties of club-foot, characterized by a certain amount of inversion or eversion of

the anterior portion of the foot, in addition to the elevation of the heel, which is the marked feature.

The special form of distortion is determined by the relative power of the adductors, and abductors of the foot. The deformity is well shown in Figs. 25 and 26. The prognosis, pathology, and treatment of both the compound varieties, are essentially the same as that of simple talipes equinus, except that, in order to control the lateral inclination of the foot, it may be necessary to have the sole of the shoe divided transversely, at a point corresponding to the transverse tarsal joint (Figs. 12 and 13).

CHAPTER V.

CONGENITAL AND NON-CONGENITAL TALIPES CALCANEUS. — CAUSES. — TREATMENT. — CALCANEO-VARUS AND CALCANEO-VALGUS.

I NOW invite attention to another deformity of the foot, viz., *talipes calcaneus*, which, like the varieties hitherto described, occurs both as a congenital and a non-congenital affection — the two varieties differing so greatly, both in pathology and in treatment, as to demand a separate consideration. The congenital form is almost as rare as equinus. The essential characteristic of talipes calcaneus, is depression of the heel. In the *congenital* variety, which we will first describe, there is, in addition to the depression of the os calcis, marked flexion of the dorsum of the foot against the front of the leg (Fig. 27), and the condition is exactly the reverse of talipes equinus, in which there is an extreme degree of extension of the foot. The foot is retained in a flexed position, by the contraction of all the muscles whose tendons pass over the front of the ankle-joint, and stand out very prominently.

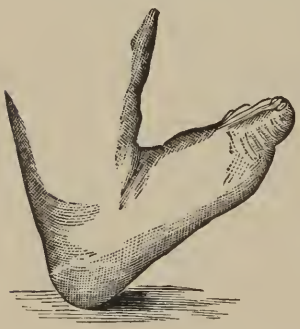

FIG. 27.

The *bones* undergo very little change in their relative positions; indeed, the deformity is only an exaggerated degree of one of the

natural motions or positions of the foot, and the deformity, in the infant, can be easily overcome by gentle manipulation; but on removing the hand, the foot is immediately drawn up again, by the contraction of the muscles. The facility with which the foot can be brought to a normal position, indicates that structural shortening has not taken place, either in the flexor *muscles*, or in the *ligaments* on the anterior part of the foot. In rare cases, however, the foot is held firmly in its flexed position, in consequence of the structural shortening of the anterior muscles of the leg and the anterior ligaments, and operative proceedings may be necessary to overcome the distortion.

TREATMENT.

Congenital talipes calcaneus, which is only seen in infants and young children, may be regarded merely as a malposition from intra-uterine pressure. It is the least important, as well as the rarest deformity of the feet, and yields readily to the simplest treatment. Surgical interference is not usually required. It is only necessary in ordinary cases to extend the foot, to make frequent passive motions of the ankle-joint, and to use frictions with the hand, over the anterior muscles of the leg. The cure may be hastened by the application to the front of the leg and foot, of a well-padded metal splint, which should be straightened from time to time, as the foot improves.

In the rare cases in which there is permanent contraction of the flexor muscles, namely, the extensor longus digitorum, peroneus tertius, extensor proprius pollicis, and the tibialis anticus, they should be divided as they pass over the ankle-joint, where they are tense and prominent. A sharp-pointed tenotome is inserted,

close to the inner side of the extensor longus, and carried outward, beneath the tendon of that muscle, and also of the peroneus tertius, which are then divided towards the skin; the knife is withdrawn, and re-introduced and passed inward, beneath the anterior tibial and extensor pollicis tendons, which are divided in the same way. You will avoid the risk of puncturing the anterior tibial artery, by keeping the point of the knife close to the tendons to be divided. The wound should be immediately closed with a pledget of lint, retained with adhesive plaster and a bandage.

After three or four days, you should begin the mechanical treatment, which consists in the application of the padded metal splint, in the manner just described. The foot should be extended daily, and you will, in the course of three weeks, without much pain or inconvenience, be enabled to bring it to a state of complete extension. When this has been accomplished, the splint may be left off for an hour or two each day, and passive motions and manipulations practised, until the tendency to contraction has ceased. This is of the greatest importance, also, to the development of the infantile muscles. There is but little tendency to relapse, and in the after-treatment no retentive apparatus is required.

NON-CONGENITAL TALIPES CALCANEUS.

This deformity of the foot has been designated by Barwell as *talipes cavus*, by Bauer as *talipes simplex sive plantaris*, and by others it is described as *talipes calcaneus valgus*. I prefer to describe it under the name of, *non-congenital talipes calcaneus*, because of its resemblance, in the early stage, to congenital calcaneus, for, in addition to depression of the tuberosity of the calcis, there is, in the early stage, slight elevation of the anterior

part of the foot (Fig. 28). At a later period, however, the foot becomes flexed upon itself, at the transverse joint, the anterior portion is bent downward, the transverse arch is lost, while antero-posteriorly, the sole is deeply arched. This affection is usually of paralytic origin, the paralysis being generally confined to the triceps suræ, but, sometimes it extends to all the extensor muscles.

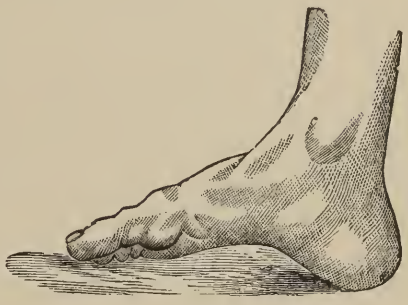

FIG. 28.

I cannot better describe this deformity

FIG. 29.

than by directing your attention to the appearances presented by this cast (Fig. 29), which was taken from the right foot and leg of

a girl eleven years old, who was the subject of infantile paralysis, affecting the triceps extensor muscles of the leg, at two and a half years of age. It will be noticed that the foot, in front of the transverse tarsal joint is bent downward. The flexion of the anterior part of the foot is secondary, and is due to the action of the peroneus longus, chiefly, assisted by the posterior tibial, these muscles supplementing the sural muscles, as extensors of the foot. These muscles acting, while the triceps suræ are paralyzed, in their efforts to keep the foot normal by their extending force, must necessarily drag down the anterior tarsus, so that the ball and the heel approximate each other, and the sole is so deeply arched that a mouse could run under it without touching it, as was the case in Lady Hester Stanhope's foot, which was remarkable for a high plantar arch. The transverse arch has disappeared. The foot is also a little rotated outward, by the action of the peroneus longus, its farther rotation being prevented, by the action of the posterior tibial. It will be perceived that the head of the metatarsal bone of the great toe, is forcibly depressed. This is due to the normal contraction of the peroneus longus, which is unopposed in this part of its function. It will be seen also that the os calcis is depressed, so that the patient walks on the tuberosity, instead of walking upon the normal under-surface of the bone, and that the only parts of the foot which touch the ground, are the ball of the great toe and the tuberosity of the heel. The muscles of the calf are wasted, owing to the long-standing paralysis, and the back of the leg, from the knee downward, is very nearly straight, instead of presenting the curved outlines observed in the normal leg. Even the os calcis has lost its prominence, and the tendo Achillis feels like a thin and narrow ribbon. The limb is cold, the circula-

tion languid, and the patient suffers easily from chilblains; in fact, we have here the usual concomitants of a paralytic limb.

You can imagine that the inconvenience caused by such an affliction is very great, and the lameness considerable; the relaxation of the ligaments deprives the foot of all useful motion and firmness, and walking is accomplished with great difficulty without the aid of artificial support.

The usual *cause* of non-congenital calcaneus is infantile paralysis, principally confined to the sural muscles; but sometimes all the muscles below the knee are paralyzed, except those whose contraction produces the deformity. It may also be caused by improper union of the tendo Achillis after section or accidental rupture, by separating the ends too far before they had united, or it may be produced by the contraction of a cicatrix resulting from a wound or burn on the dorsum of the foot. A condition of the foot resembling non-congenital calcaneus is artificially produced among the Chinese women, of the higher order, by confining the feet by short shoes and improper bandages during infancy (Fig. 30).

FIG. 30. (After Adams.)

It has been found, upon dissection, that the relative position of the *bones* is considerably changed. We have already alluded to the depression of the tuberosity of the os calcis, while its anterior part is elevated; and, as a consequence of this, there is a great obliquity of the astragalus, its trochlea projecting posteriorly, while the articular surface of the tibia is thrown forward upon the neck of the astragalus, and the anterior

portion of its trochlea. The bones, in front of the transverse tarsal joint, are pulled downward, by the action of the peronei muscles, diminishing the length of the foot, and increasing the longitudinal arch.

Owing to the changed position of the bones, the *ligaments* on the dorsum of the foot, and behind the ankle-joint, are elongated; those in front of the ankle-joint and those in the sole, together with the muscles with which they are connected, are contracted.

When the distortion arises from paralysis, and is of long standing, the *muscles* are in a state of atrophy and fatty degeneration, more or less complete.

The *prognosis*, in cases of this deformity arising from paralysis, is usually unfavorable, and our treatment can only be palliative. We can remove the deformity in a measure, but we cannot give power to the muscles.

TREATMENT.

In paralytic cases, if the patient is seen soon after the distortion has begun, we can not only prevent any considerable deformity, by the use of suitable appliances, but muscular power can, in a measure, be restored by means of electricity or galvanism, heat, stimulating applications, rubbing, &c. The apparatus which I would advise, is the one I here show you (Fig. 31, Tiemann's). It consists of two lateral steels, carried up the leg and secured by a band around the calf, with a joint at the ankle. The anterior part of the foot is depressed, and the heel is elevated by a steel spiral spring, placed on a pivot, and playing between brackets of the leg and ankle-stem. This apparatus, I consider preferable to the india-rubber cords fastened posteriorly to the heel below, and

to the calf-band above, so as to imitate the tendo Achillis. If, however, the latter apparatus should be employed, the spur projecting from the posterior part of the heel should be dispensed with because it is in the way, and liable to catch surrounding objects, especially when descending the stairs, and the cord should be fastened directly to the heel by means of a leather strap.

You may be surprised to learn that this affliction is usually overlooked in the early stage, and, when it is recognized and brought to the attention of the surgeon, considerable deformity has taken place. The earlier it is treated, the more readily is the distortion overcome. When, unfortunately, much time has elapsed before the deformity is discovered, there is marked depression of the os calcis and great increase of the longitudinal arch of the foot, and the ligaments and muscles have adapted themselves to the altered condition of the foot, so as to give it a considerable degree of firmness, which enables the patient to walk quite well. In such a case, while physiological treatment and mechanical appliances may increase the usefulness of the foot, and may be used in appropriate cases, it is extremely probable that tenotomy would, on account of the paralysis of the muscles, allow the foot to dangle about and become almost useless, and render some mechanical apparatus indispensable. Operative treatment is less appropriate in this, than in other forms of club-foot. In exceptional cases, it may be necessary to divide the contracted extensor and other tendons, and the plantar fascia, and then proceed to

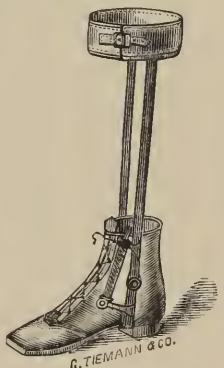

FIG. 31.

extend and elongate the foot by the use of a Scarpa's shoe, and by pressure on the dorsum of the foot. When the distortion has been reduced, the patient may wear the shoe which I have just described, for the purpose of supporting the limb. I desire to warn you against exciting the expectations of your patient too much. He should be informed that the treatment can only be palliative, — that there is no reasonable probability that the paralyzed muscles will regain their normal power.

In cases of talipes calcaneus, the result of non-union of the divided tendo Achillis or of too great an elongation of the reuniting medium, Dr. Little advises incising the edges of the un-united tendon, or dividing the uniting medium with a tenotomy knife, and then approximating the ends by placing the foot in an extended position. In such a case, he has known an abundant effusion of plastic material to take place, and firm union of the tendon, at the end of two weeks.

When the distortion is caused by cicatricial contraction, on the front of the leg or dorsum of the foot, such a treatment should be adopted as seems to be indicated in each particular case.

Calcaneo-varus and *calcaneo-valgus* are slight and unimportant modifications of talipes calcaneus. Their characteristics are sufficiently indicated by their designations, and the pathology and treatment are essentially the same as in the simple varieties, and do not therefore deserve separate consideration.

I have now, gentlemen, completed what I have to say to you upon the subject of club-foot, in accordance with the plan which I proposed for myself at the outset. No attempt has been made to treat the subject exhaustively, or to amuse you with novelties, and I have endeavored to avoid *ad captandum* or random state-

ments. It has been my purpose to give you, in as concise and simple a manner as possible, the results of my personal observations and reflections upon the subjects we have considered, to unfold to you, as I stated at the outset, a much-neglected, but a most attractive chapter of modern surgery, and to impress upon you general principles which I trust will enable you to treat club-foot, wherever you meet it, without the assistance of the specialist or the hospital surgeon.

To those of you who may desire to study more fully and more in detail the subject of talipes, I would recommend the great work of Mr. William Adams, of London, by far the ablest monograph upon this subject in any language.

In conclusion, gentlemen, I desire to express my sincere thanks for the interest you have manifested and for your uniform courtesy, and to wish you every success in the profession of your choice.

Stereotyped and Printed by Rand, Avery, & Co., Boston.